

AVIATION WEEK

A MCGRAW-HILL
PUBLICATION

September 2, 1957 50 cents

Helicopters Lick
Terrain in Hunt
For Oil Fields



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he's watching the progress of
the Air Age from his machine...



Piston engines... jets... and now, missiles. Foote Bros. engineers are working the steady advance of American air progress from their machines. They're not only watching it—they are an important part of it, because, at this moment they are helping produce components capable of performance unachieved of a short time ago.

At Foote Bros., yesterday's technology, methods and standards of precision are obsolete. Today, these men are working with new metals in new ways, with greater precision, to produce lighter, stronger and more reliable gears, power transmissions and actuating mechanisms for the air age of tomorrow.

It is the willingness to innovate, the ability to anticipate, and the determination to excel that have helped Foote Bros. engineers and production men keep pace with, and earn the confidence of, the aviation industry.

We may be able to help solve your problems involving precision gearing and actuating mechanisms, and would welcome the opportunity of talking with you.

This advertisement made for the Great Industrial Gearing Trade



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Better Plans Handmade Here Through Better Plans

FOOTE BROS. GEAR AND MACHINE CORPORATION
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"Go-Anywhere" tires—



and fuel you can "Roll With You"

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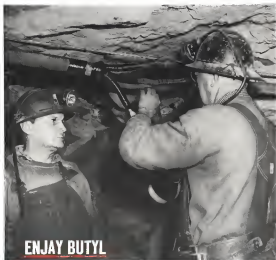
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The Allison Division of General Motors has done a remarkable job of engineering, scheduling, and production on the T56 military prop-jet engine, and its commercial version, the B5L. We are pleased to have a part in this engine and in Allison's fine production record; the Jet Division of Thompson Products produces major parts for the compressor and turbine sections of the T56 and the B5L.

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the bird
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tail!



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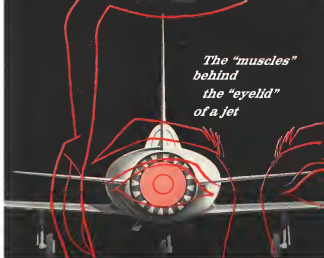
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CLIP AND MAIL

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behind
the "eyelid"
of a jet



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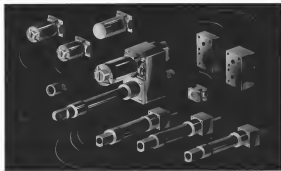
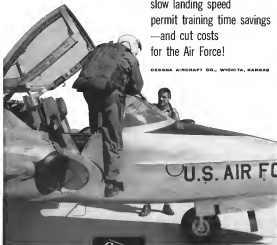
Aircraft Division

MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O.

**NOW...
AN EASIER STEP
INTO FIRST-LINE JETS**

To fit the USAF's new concept in Cadet training, the Cessna T-37 is now in operation. Side-by-side instruction, easy maneuverability, slow landing speed permit training time savings—and cut costs for the Air Force!

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New Airborne modular actuators give you greater design freedom, help eliminate specials

Airborne's new modular concept of linear actuator design is based on a system of standard components. These components—cylinders, pistons, jacks—see grouped in three broad operating capacity classifications: L12—up to 550 lb., L16—up to 2100 lb., and L20—up to 3500 lb. All components within each classification are interchangeable.

As a result, you are no longer limited to a line of, say, a dozen standard actuators whose design is relatively fixed. Instead, you can now select any one of several hundred possible configurations from over 40 standard Airborne actuator compo-

nents. In 90% of cases, this will give you a linear actuator meeting your capacity and configuration requirements easily. Then, you have greater design freedom without becoming involved in the extra costs and delays associated with specials.

In addition, while redesigning under the modular system we have reduced the bulk and increased the capacity of many Airborne actuator components. You get more power in a smaller package, saving valuable weight and valuable space.

Write today for further information on Airborne's new modular actuator line.



Show the complete line of Airborne products and select components.

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NEW MODULAR ACTUATOR
CATWING 274

Designs within the actuator line are available in a variety of sizes for use in many different applications. Write for complete literature.



GEORGE A. LINDER, President, Assistant Chief Design Engineer, responsible for Propulsion and Mechanisms Design, is a graduate of the University of Minnesota. Among his other responsibilities at CONVAIRE-SAN DIEGO, he was Assistant Project Engineer on the first successful delta-wing aircraft.

"Engineers—here's the story of the 'G-Limiter' development."

The specifications for Convaire's F-102A required that this supersonic delta-wing interceptor fly itself during part of a tactical mission.

To safeguard both pilot and aircraft while operating in this automatic flight mode, it was necessary to develop a "G-side" feature in the control system.

"This 'G-Limiter', as it came to be called, is an electronic measuring device which senses the angular and normal acceleration of the aircraft. Then, by comparing the "sum" to a critical reference, this device anticipates the point at which the structural limits of the aircraft will be exceeded, and initiates corrective action.

"You, as an engineer, will appreciate this kind of creative assignment—and the resulting atmosphere of accomplishment at CONVAIRE-

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How the Holley three dimensional cam functions as an automatic co-pilot



The job of the Holley Power Control for jet aircraft is to sensitively control engine power according to the pilot's requirements and, at the same time, make automatic adjustments for split-second variations in altitude, pressure and temperature. The "brain center" of advanced Holley controls is a three dimensional cam which is so contoured that it can adapt itself to all combinations of atmospheric temperature and pressure, from Thule to the

Equator and from sea level to extreme altitudes.

In addition to the automatic compensations made for the pilot by the three dimensional cam, it interprets the pilot's request for changes in power. It's the most important link between cockpit and engine.

The three dimensional cam, like the power control itself, is designed, engineered and manufactured by Holley—one of the world's foremost power control manufacturers.

Typical "brain center" of a Holley aircraft engine control. Note the delicate mechanical nature. Each plays a vital role in automatically regulating the engine under varying conditions.

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READINGS YOU CAN RELY ON



For Remote Indications, Montrose Division's 1-inch Synchro Indicator Provides Super-accuracy, Rugged Design, Easy Readability



Montrose Division presents Type 26830—a single pressure synchro pressure indicator with a 950-ohm dual aperture—for measuring oil, mudfilled, hydraulic and torque pressures in a variety of ranges—depending on specific operating requirements.

Where desired, it is available with various duals to indicate fuel flow, heading, position, and other factors, when used with appropriate transmitters.

Electrically connected to a remotely located synchro transmitter to provide a remote indication of transmitter output signal, its hollow-filled and hermetically-sealed construction assures long, trouble-free life under adverse environmental conditions. Dual and pressure markings are available with R-455-AH radium, AN-4-L fluorescent or white white paint.

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Montrose Division manufactures a complete line of synchronous indicators and transmitters, remote indicating systems, warning horns, battery-charging control switches for pressure applications, and dynamometers. Montrose Division, Bendix Aviation Corporation, South Plainfield, N.J.

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September 3, 1957

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AIR TRANSPORT

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Combines 6 Components in a Single 6.4 lb. Unit!**

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EDITORIAL

Facts and Fiction on the ICBM

Soviet announcement of successful test firing of an intercontinental ballistic missile produced some reverberations around the world, though the missile made its impact area. The Soviet announcement put into the public record a fact that has been well known in the Pentagon and White House for at least some months. First public news that the Soviets had begun experimental test firings of an intercontinental type ballistic missile was printed in *Avenues*, *Week* May 20 (p. 26). For the past five months, top level Pentagon and White House officials have been deeply concerned with how to contain the effects on the American people and world opinion of the inevitable Soviet announcement of this fact.

The timing of the Soviet announcement indicates clearly how potentially the relative achievements of the U.S. and the USSR in the current technological armament race loom as a support of foreign policy. We learned last year after the Suez crisis (AW Dec. 3, p. 21) that the cry of ballistic missiles had dawned and heralded the long range ballistic missile, whether actually used against an enemy or not, would add up to a new weight to the international balance of power. The Soviets first used their intermediate range ballistic missile capability as a diplomatic threat against England and France in the Suez crisis. Once again the Soviets have worked for a purposeful moment in international diplomatic negotiations to turn their ICBM had into a point on the diplomatic conference poker table. The Soviet announcement timed the successful ICBM firing in "a few days" before the official release. That may well be true. The first experimental firings began last winter, and there have been a number of test firings since at the regular intervals that distinguish experimental testing from the routine firing of samples from a missile production line. It is possible that the most recent Soviet ICBM firing was the first reasonably successful launch in the experimental program and was considered the first sufficiently solid technical performance to warrant a public boast.

At any rate, the Soviets placed their announcement to get maximum diplomatic value in the current diplomatic conference and to back an increasingly tough policy by a vote the U.S. It will take some time before it becomes clear exactly how both the Soviet announcement and the official U.S. counter statements by Secretary of State John Foster Dulles and Deputy Secretary of Defense Donald Quarles are evaluated by our allies and the world.

Many Americans will wonder how a technically advanced country such as the Soviet Union can even be in a position to seriously challenge the U.S. in such a technologically sophisticated field as ballistic missiles. The fault lies not with the quality or industry of U.S. technology but rather with the lack of imagination courage and candor in our political leaders. Missile men the world over (except perhaps in Stalinist versions of Russian technological ideology) are men of action. Dr. Robert Goddard, in the pioneer of modern rocketry, had to overcome no official support and little public backing to continue his important work. The

German pecked up Goddard's basic technology and went on to develop the V-2, first missile ballistic missile. With the fall of Germany in 1945, both the U.S. and USSR had access to the substantial accumulation of ballistic missile technology developed by the Peenemunde project. Both countries in effect started from scratch in the ballistic missile business in 1946.

We have the word of a Soviet Air Force Colonel, G. A. Tolstoy, an anti-Stalin defector who was in charge of engineering the armament and missile brains of Germany to work for Russia, that ballistic missile development was given top priority from the very start of the Soviet's post war armament program. It was not many years after the end of World War II that Soviet development of the German V-2 began impacting in Sweden after test firings over the Baltic Sea.

This country too began an aggressive development program based on the German V-2 and also independent approaches by General, the Martin Co. and North American Aviation Inc. that produced significant new knowledge.

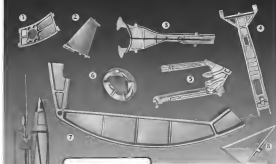
In the military estimates were of 1949 ordered by President Truman and executed by the then Defense Secretary, Louis Johnson, the ballistic missile development program virtually responded along with the 70 group Air Force program.

For the next five years—from 1949 to 1954—the pace of ballistic missile development in this country slowed to a leisurely walk. During the same period the Soviets continued their top priority on ballistic missile development. It was the old story of the tortoise and the hare. While the U.S. has taken a forced pace through an "economic budget" sleeping pill, the Soviet tortoise plodded on at a steady if not spectacular pace.

There is no magic on either side of the Iron Curtain in ballistic missile progress. It is slow learning by trial and error, and the rate of progress is determined more by the time and scope of sustained support than by any "secret technological breakthrough." When in 1954 the U.S. suddenly became excited about the ICBM because of the feasibility of hydrogen warheads, money and manpower were poured into the program and enthusiastically. Instead of concentrating on two, or at the most three, different programs, Defense Department disrupted both money and the limited technical resources then available as no less than five ballistic missile programs, including those in the strategic, long-range area of intermediate range. Thus, our leaders of ballistic missile development have ranged from a promising start through head starvation to a glut of funds that cannot be assimilated by our limited technical resources to develop the incapable, lost years dominated by the "boom and bust" cycle. Against this background, the Soviet situation has plodded steadily forward, not notably dented by failures, getting all the foreign technical assistance they could and backed by top priority from their political leaders.

It is a slow today, we are running such and such with the Soviets in the ballistic missile race—a race that we would have won hands down if our political leaders had supported our technological capabilities. —Robert Hertz

DEPENDABLE FORGINGS for... the Jet-Missile Age



KEY TO FORGINGS ILLUSTRATED

- 1 Jet Engine Pk. Turbine - 11 In. - 17 inches
- 2 Jet Engine Vane - Turbine - 19 In. - 12 inches
- 3 Aircraft Support - Aluminum - 18 In. - 10 inches
- 4 Aircraft Ring - Aluminum - 20 In. - 14 inches
- 5 Aircraft Spinning Gear - Aluminum - 20 In. - 10 inches
- 6 Aircraft Ring - Aluminum - 24 In. - 10 inches
- 7 Aircraft Case Frame - Aluminum - 416 In. - 142 inches
- 8 Aircraft Vane - Aluminum - 8 In. - 10 inches

Faster and faster, higher and higher—greater stresses, increased temperatures — all leading to continuously increasing dependence on forgings — and in the forging field there is no substitute for Wyman-Gordon quality, experience and know-how.

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WHO'S WHERE

In the Front Office

Walter J. Johnson and Norman Pelt, directors, Standard Steel Corp., Los Angeles, Calif. Also Robert C. Johnson, a vice president.

Richard H. Foley, vice president and general manager, Hyman Aircraft Services, Inc., Pasadena, Calif.

A. F. Anderson, vice president and general manager, The Vincent Manufacturing Corp., Los Angeles, Calif.

Earl D. Wilson, vice president-developing, Lark Aviation, Inc., Longhams, N. Y.

R. E. Eddy, a vice president, Vulcan Inc., Detroit, Mich.

Roy Robert Sargent, division vice president, American Division, American Machine & Foundry Co., New York, N. Y.

Patric G. Donnelly, vice president passenger service, Trans World Airlines, Inc., New Orleans, La. Also John H. Chomson, new handling special assignments for the president's office.

Leonard Frensch, a vice president, Airtron Inc., London, N. Y.

Bertson Cole, corporate director, machine tool and distribution, International Machine Tool Sales Corp., Hempstead, N. Y.

Honors and Elections

The American Society of Mechanical Engineers has announced that Dr. Charles Stark Draper, third of the Smithsonian Engineering Department and Director of the Instrumentation Laboratory of the Massachusetts Institute of Technology, has been awarded the Shellen Medal, which is awarded only for "great and unique contributions in engineering science." Dr. Draper discovered a new principle for controlling great load force moving platforms at moving targets.

Capt. R. L. Wiggin, retiring from United States after 38 years of flying, was the first recipient of Flight Safety Foundation's newly inaugurated "Patron's Pilot award." This award will be presented to other pilots for time to time with their safety achievements reported and awarded in Flight Safety Foundation.

Changes

Clifford A. Bess, engineering manager, Emerson Electric Division, Emerson Manufacturing Co., St. Louis, Mo.

Elmer E. Bensen, general manager, Wyle Associates, El Segundo, Calif.

Lawrence M. Shaw, director of engineering, Canadian Applied Research Ltd., Toronto, Canada.

The Engineering Department, General Electric and Industrial Division, Pico Corp., Philadelphia, Pa., announced the following appointments: James B. Williams, director engine, engine engineering, Bureau A. Mott, director engine and control engineering, John Coleman, chief mechanical engineer.

(Continued on p. 105)

INDUSTRY OBSERVER

McDonnell Aircraft Corp. is holding two prototypes of a turbine-powered helicopter for troop transport missions. Powered by two engines, first prototype is scheduled to fly in about Oct. 1. USAF provided the engine for the prototype, with McDonnell having other ones.

De Havilland Gyron engine with afterburner (AW Aug. 26, p. 52) has been run at more than 27,000 lb. thrust. Highest figure previously announced for the engine is 25,000 lb.

New monocular ranging technique for infrared systems developed by General Electric gives accurate target range from single optical sensor, opening the way to simplified fire control systems. Ranging feature requires only one line of sight to target. Application of monocular ranging to proposed infrared gunnery warning indicator (AW Aug. 11, p. 77) could greatly increase its ability by giving pilot an indication of intruder distance as well as bearing.

Sikorsky S-61 is a conventional version of the company's gas turbine-powered development of the S-58 helicopter now flying as an experimental version. S-61 would be powered by two General Electric T58 turbine engines mounted on top of the fuselage with the pilot's cabin moved down to the main passenger cabin level. Passenger capacity would be about 30 people.

Full scale component tests using certified test turbine blades will be run by Wright Aeronautical Division of Curtiss-Wright Corp. In turbine engine development, certified blades will be checked for stresses at 3,700 psi in gas stresses between 2,500 and 2,900°. Blade root attachment also will be studied.

Northrop will receive afterburner model of General Electric's J85 jet engine for its T-38 supersonic trainer. North American will get a model of the engine without afterburner for its Sabreliner jet utility trainer transport. First delivery of the J85 will be made next summer.

First Pershing Corporal missile is scheduled to be fired by the British Army on new Scout missile test stage at the White Sands. It is 1955 British Army will get the U. S. developed and produced Corporal short range surface-to-surface missile for its first operational guided missile tests.

Bell Helicopter Corp. has developed a new turbine generator for helicopter instrument power which will permit the Army to use this fuel in evaluation as part of an improved guard layout designed by Bell using available equipment. New instrument uses a five inch cathode ray tube to give a more accurate indication of change in attitude than is available from aircraft type horizon display.

Blackburn NA 39 supersonic transport has been under construction for the Royal Navy will be powered by two de Havilland Gyron Junior engines.

Current inter-war design possibilities include use concept employing aircraft propellers. Army feasibility study is considering this device for increased movement of supplies to troops at front. One idea would provide a lightweight shielded power package.

Studies are under way at Lockheed Aircraft Corp. on the feasibility of manufacturing 1049H passenger cargo configurations fitted with A2000 520-D15 turbo-prop engine which will power the company's Electra transport.

All test use of 31 HANP (High Altitude Stranding Penetration) rocket fired by Navy in tests at Wallops Island, Va., range was successful. Based on Army tests, HANP is fired from aircraft using solid propellant, sea and land tests at altitudes above 20,000 ft. (AW Aug. 26, p. 51). Penetration rocketed HANPs are to be fired in October. Weather instruments are to be evaluated next spring. Altitudes above 100,000 ft. already have been reached.



HOW THE SILICONES MAN HELPED...

Build a Gyro for Straight Shooting!

Accuracy that could hit a fly from a screaming roller coaster... no rugged that it can be used to drive a rifle without sagging its operation. That's the "impossible" fine control gyro built by Minneapolis Hoeswell, Aeronautical Division. Known as the HGS-6 (Hermetic Integrating Gyro), lightweight and small enough to hold in the palm of your hand, it supplies the "sense of balance" necessary at supersonic speeds.

Operating in a viscous fluid under wide limits of temperature and pressure, such can be no less than perfect. What material was used? "OF" rings of Union Carbide Silicone Rubber.

Fabricated by Hoeswell Products Company, Racine, Wisconsin, these "OF" rings were tested from -65 to +200 deg. F., at simulated pressures from ground level to operational altitudes. The firm "Union Carbide" is a trademark of U.C.C. In Canada: Hoeswell Company, Division of Union Carbide Canada Limited, Toronto 7, Ontario.

Under such rigid tests, Union Carbide Silicone Rubber showed outstanding sealing qualities and resistance to compression set.

This is another example of how the UNION CARBIDE Silicones Man has helped solve an "impossible" problem. A booklet—"Look to UNION CARBIDE for Silicones"—describes silicone rubber and many other silicone products. Write Dept. AW-61 today. Silicone Division, Union Carbide Corporation, 34 East 52nd Street, N. Y. 17, N. Y.



Airlift Pressure

Despite Defense Department's severely budgeted fight for increasing pressure from the armed forces, particularly the Army, for renewed strategic airlift capabilities. In addition to the Martin Siskin concept (see p. 20) there are a number of other possibilities with load capacities and equally modern aircraft. The agreement says both between and within the services. Senior Army spokesmen are beginning to cast less about which program is adopted than they are concerned over the delay in action on the program. Sudden rise of interest in one capability to fight a limited or Korean type war adds new urgency to the demand for adequate airlift. Army is investigating some new prototype designs for fast action in limited war areas, but top officials fear they could not get sufficient funds to make a streamlined division to the least with its lightning touch.

D. C. Airport

Prospect for a new airport to handle some of World War II's increasing air traffic congestion is still uncertain. Congress has appropriated \$12.5 million for the project, but with this legislation "that no funds shall be expended for construction and development... until the President shall make a report to the Congress with a recommendation as to the site." The recommendation is due Jan. 15. The President and the Department of Commerce after studies and on studies over the past decade have overwhelmingly recommended location at Herby, Va. The legislation seems that should make a recommendation, as most staff, opponents of this location will have another opportunity to kill off the project, as they have been successful in doing so far. Meanwhile, the new study to determine a location will be directed by Lt. Gen. Edward P. Quigley, presidential assistant for aviation planning.

Deep Freeze

First assault battle for Antarctic Operations Deep Freeze III, this year's scientific expedition to the bottom of the world, will take off this week. Total of 44 ships will sail out. Light air Douglas C-119 Cherokees from 1955 Air Force. These are Navy aircraft being from the Lockheed P-3V to the declassified Otter. All attached to Air Development Squadron Six at Quonset Pt., R. I. There will be 15 Navy helicopters on hand for this winter's operation.

Enlistment Stretch

Following USAF's bid (AW Aug. 26, p. 21) Navy will acquire five new enlistment of aviation training capabilities beginning Jan. 1. Enlistment will result from basic and a half years of active duty after training contract of the present two years. Training costs more than \$100,000 for each pilot. Excerpt from the new legislation—November (News Aviation Guide).

Alaska Certification

President Eisenhower last week signed a bill authorizing permanent enlistment of U. S. Alaska residents but still so "Alaska" as a grounds for the enlistment of U. S. Alaska residents is "inactive." The President held the bill on his desk until the last possible moment before

Washington Roundup

deciding to sign it to give confidence in other means that opened opportunity to the legislation in Commerce Secretary Weeks could lead to a veto. The act has a great permanent operating authority to Pacific Northwest Airlines, Alaska Airlines and a note segment of Northwest Airlines. President Eisenhower said in signing the bill that "it was hoped that Alaska Airlines and Pacific Northwest Airlines might effect a merger." But since no merger has taken place, he added, members of the two airlines have "been by about \$900,000. At the present time, that change is over \$1,000,000."

Guaranteed Loan

Legislation pending for government guarantee of private loans to local service centers managed to pass by Congress after having shaken off two proposed amendments that would have killed the stage of the bill. Originally, the Senate bill excluded helicopter services but, an amendment that the Civil Aeronautics Board would watch the segment of the industry "very closely," the measure was passed to include the helicopter lines. Another amendment that required in the Senate would have limited loans to commercial aircraft manufactured under a U. S. type certificate would also be the counterpart of the loan legislation. Senator Mike Monroney (D-Ga.) pointed out that this would have the effect of excluding loans to three aircraft—Boeing F-27, F-27, F-27, the proposed Douglas 7940 (AW March 16, p. 18) and the first Jetair. He added that some of the least one could expect in commercial operations tomorrow is the use of "Mutt's planes," the legislation was in motion to provide loans for an aircraft which, in the view of the CAB would actually improve the service.

Claims Against Rails

Supplemental claims are increasing their claims against railroads for reducing railroad rates in bidding on rail line business to a total of \$144 million. Five lines already have won damages of \$45 million from the U. S. District Court for the District of Columbia. Twenty six additional lines have won judgments in the case pending before the U. S. Court of Appeals for damages of \$99.6 million more. Meanwhile, Congress passed legislation in the amendment last explicitly authorizing the railroads to refuse to bring such an industry business in effect on the court case will undoubtedly be the subject of prolonged legal arguments. Congress, however, stipulated that the legislation was to have no effect.

Color Barrier Crack

Important crack in aviation's color barrier was made by appointment of James O. Flinn, a Negro, as Third World Airline executive assistant to the director of personnel and industrial relations. Appointment is first of Negro to an aviation job in such capacity.

Flinn has been Air Force pilot and airport manager in a position at Los Angeles University with extensive aviation and business experience. TWA said it has no change of racial discrimination in hiring from which could be flight crew jobs (AW July 3, p. 41), from justice from Vice President Richard Nixon and the United League of New York, among others, for the action. At the same time pressure on the airlines to hire Negro race members hasn't slackened off nor is expected to relent. —Washington Staff

USAF Spells Out Procurement Policies

Soviet firing won't affect ICBM program, Douglas tells West Coast industry; Irvine stresses cuts.

By Richard Sweeney

Los Angeles—Russian announcement of successful firing of an ICBM should not be surprising, and more if evidence supporting the announcement shows up, Air Force Secretary James Douglas does not feel it will cause USAF to make any change in its ballistic missile program.

Douglas and Lt. Gen. C. S. Irvine, USAF deputy chief of staff, separately, were featured speakers at a large meeting of Southern California aircraft industry, modern aircraft test work by Los Angeles Chamber of Commerce and Los Angeles Air Procurement District, at which USAF future procurement plans to their effect this area were outlined.

Missile Philosophy

The secretary went on to point out that:

- Ballistic missiles are only one method of delivering a warhead, and for some time yet they will not approach the reliability of a manned aircraft in risk areas of designated targets.
- USAF, which presently leads the world in military capability with its B-47 and KC-135 fleet, the B-52 and upcoming KC-135 replacement, feels the development of a long range, superior missile is needed. WS-116A is a high priority project.

Douglas said he could not give the date for a decision on the next step as the WS-116A program.

- Pioneer bombers, such as B-58, which figure in long range delivery systems.
- All long range delivery systems are financed by developments as yet not fully defined.
- USAF will go ahead with Atlas and Titan, and other long range delivery systems such as bombers plus strategic missiles and will continue some distance down the road before decisions on their future are made.

In addition, Douglas said, in the tactical field USAF must provide advanced fighter bombers, tactical missiles and strategic missiles. New aircraft capability in our area hand led as outlook, the G-12 was cancelled and no production money for C-119A is allotted in this year's budget although existing tactical contract will cover project slowly until new design work opens.

Concerning Southern California specifically, Douglas indicated there will be no more orders in the area this

year. Strathmore for Lockheed F-104 and Convair F-106 have extended programs one year and have had a strike-increase overall effect, Douglas said.

The secretary told the meeting that 75 to 80% of USAF plans and subsequent work which is done in the metropolitan Los Angeles area will stay unchanged this fiscal year. He also declared that dispersal is a dead issue for the area's concentrated aerospace industry.

Industry Commented

Douglas commented industry for "large savings that have been processed and delivered, and to some extent without any effect upon production schedules." For its part, USAF will reduce its military personnel by 25,000 by Dec. 31, to bring USAF strength down to 908,000. Its civilian personnel 5% or 50,000 will be lopped from payrolls by Oct. 31.

Irvine told the assembly of 1,300 industry representatives that USAF was finding it necessary to follow certain safeguards, chiefly one in which senior

USAF commanders and members of the staff work out a system of assignment priorities and mission objectives for future assignments, and development and production programs are established on this basis.

While the picture is not new, Irvine considered it a new gets under way, as well as a "more rapid rate of all development projects" referring only those which show distinct promise for significant operational advantages.

Small assignments or low priority projects will have to fall by the wayside.

Concerning the specific impact of delta availability and mission allocation on the primary and supporting aircraft, Irvine said:

- Many major computer and their sub-structure will require new designs, developments or development cancellations of projects as a result of resource priorities and schedule changes, not because it is a certain computer project is needed in a specific area.
- Sharp reduction in requirements for high bay facilities will follow as missile production rates and that of manned large aircraft decrease. USAF means to shut down its 100,000 sq ft of present facilities which are unusable for production manufacturing, maintenance and storage purposes, although new facilities the missile program aspect for test and assembly will have to be built in related branches.

• Fewer dollars this fiscal year—about 6% of the site in the last six months of last year—will be spent on relatively few new projects, Irvine stressed.

He was really cooperative for these dollars, companies should take a hard look at their management and engineering personnel and production techniques with a complete review of "front of the" cost, reducing excess engineering and manufacturing space and personnel, unnecessary personnel and aircraft and plant operating expenses. "We must obtain really good hardware and less overhead," he said.

Fund Limits

Since USAF must also within present fund limits Irvine said, it is setting up programs and procedures which will control and forecast expenditures right down to the plant, so funds are not decreased month by month, quarter by quarter, he declared and by comparison. If expenditures are over estimates, quantities will be reduced, and if actual costs get too high USAF may cut the program "not because we want to, but because we must stay within the

USAF Ballistic Missile 'Who's Who'

Principal contributors in Air Force ball missile program, and their roles, are as follows:

- Atlas.
- Aerospace General.
- Nike Cast General Electric.
- Penetration North American.
- Guidance General Electric (ground based units and missile and flight control computer facility).
- Titan.
- Aerospace Martin.
- Nike over Aero.
- Penetration Alliant-General.
- Guidance Aerospace Research Arms (in orbit).
- Ball Telephone Laboratories (ground based units) and Sperry Rand (computer facility).
- Titan.
- Aerospace Douglas.
- Nike over General Electric.
- Penetration North American.
- Guidance A. C. Sperry (in orbit), Ball Telephone Laboratories (ground based units).

system planned delta hours."

He urged advanced manufacturing techniques such as numerical and tape control of machines, use of electronic data processing and audio random tape recording which will result in cost savings of hardware per hour labor and unit production at design per engineering hour.

Concerning subcontractors, Irvine said USAF will continue to acquire new firms and modernize contractors to which contract a substantial portion of their workload is processing firms and small businesses, USAF wants to make sure subcontracting is done as a competitive basis in possible competition.

He said that:

- "Make or buy" philosophy must proceed. Contractors is expected to become the most common source of better.
- USAF does not want a general or associate contractor to build subcontractors or to tool up to produce what he could buy elsewhere just to compete for subcontracts caused by fluctuations in its own system.

• USAF does not intend its funds to be paid to small business unless a dollar gets a dollar's worth of hardware. There will be no subsidizing the marginal, high cost, low delivery rate. Irvine also pointed out that there will be some USAF involvement in maintenance, modification and overhaul is. Air Force depot or its contractors, in order then first-line contract. USAF wants to do more than just maintain or other type of aircraft until they reach the condition of being non-flammable without major overhaul at which time they will be retired.

Russia Confirms ICBM Firing; Congress Debates U.S. Progress

Washington—Soviet Union officially announced last week it had successfully fired a multi-stage intercontinental ballistic missile over "a huge distance" and said the rocket landed in the target area.

AMERICAN WEEK could such reported the first flight test of a Russian ICBM on May 23 in 1957.

First test firing of Air Force Atlas ICBM occurred at Patrick AFB last June 11. The missile was destroyed after a 22-sec. flight because of an engine malfunction during launch (AW June 15, p. 27; July 15, p. 39).

Next Atlas firing test is scheduled for October. General Division of General Dynamics Corp. has produced more than a dozen Atlas for test purposes. USAF plans to fly a series of test flights in the next year, in 1959 and 10 operational Titan ICBMs by 1960.

Even, with Atlas G, as present returns continue, will in at least a year away from actual test firing.

(See AW drawing on p. 18.)

Truth of the Russian announcement possibly went unacknowledged in official comments. First official reaction came from Congressional members who were in Department of Defense last from Secretary of State John Foster Dulles at a press conference. This was followed 74 hours after the Russian announcement by press conference with Deputy Secretary of Defense Donald A. Quarles. His statement had been cleared by State Department and the White House.

Dulles and the U. S. has "no immediate change in our general posture," he said. He said that the Russian statement had said "we have no particular reason to doubt the veracity of the announcement" although the words were very carefully chosen and could cover much or could

cover little. In general, the Soviet statement in this area have had some surprising impact.

Quarles said the announcement "was not surprising," and that "we have to some time credited the Soviets with substantial progress in the long range ballistic missile field and have made it clear that our own work in this area field is being pressed forward by a broad front and with a high priority."

Both Dulles and Quarles pointed out the obvious propaganda value of the timing of the announcement, with the announcement taking place in London, an internal crisis in Syria and a meeting of the United Nations upcoming.

These differences in Soviet position during the past few months not been given one view or the other, Quarles statement said "and the immediate action significance of the accident was (between Russia and the U. S.) has been greatly mitigated."

Quarles also took note with earlier reports of Soviet missile program. "It will be recalled," he said, "that about a year and a half ago we went through a period when there were indications, later substantiated, that the Soviets had shut stopped as in the ballistic missile field. The Defense Department stated it clear at that time that the facts did not support the impression being created by these reports."

Let's let our Russia was today is completely wrong ballistic missile at about five per month as a regular schedule (AW Dec. 5, p. 21), adjust that figure: rate of production increases and more complete prototypes Russian ICBM firing have been going on since last week last-1955 (AW Feb. 10, p. 26, 1956). First successful U. S. ICBM firing came last June. It was a Titan Jupiter. USAF Titan ICBM has

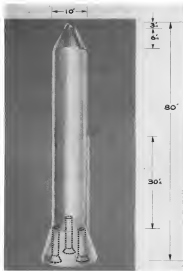
ICBM Debate

Washington—House Appropriations Committee and its report on Defense Department's fiscal 1958 budget in May that "we are no closer about the Soviet's in the field of guided missiles generally."

"In the ballistic missile field we are probably behind the Soviet Union as progress made in the progress of the intercontinental ballistic missile, the report said."

In the intercontinental ballistic missile area we are not yet probably ahead of the Soviets. As they develop points out, we are no closer about the USSR in the important field of operational know-how, but it must be admitted that the Soviets are making important progress in this area... that is an issue for consideration among our people in the consideration of our defense program."

These comments, however, USAF Assistant Secretary for Research and Development, told the Senate Appropriations Committee last year that he believed Russia was ahead of the U. S. in development of the ICBM and might be right not come up ahead on the ICBM, since they had taken a "step by step... methodical German approach" and "we directed to go for the ICBM in one jump."



AVIATION WEEK artist's sketch of the Convair Altus ICBM shows features visible in movie film that from public property control rules from Cape Canaveral, Fla., launching pad. They include external guidance package, suggested blast heat cone, two stage propulsion system.

as yet had a successful flight.

Sen Henry M. Jackson (D-Wash.) cited the "general lack of defense program" and said even the ballistic missile program—despite its priority—has been "spurred." He called for full-speed development of IRBMs and ICBMs and an increase in the production rate of the Boeing B-52 supersonic bomber.

Jefferson and target dates for achievement of operational IRBMs and ICBMs "have been postponed" and that "there has been a substantial slippage in the progress of our research and development in three weapons."

But other congressional leaders and critics are not the problem.

"While it is true that the Defense Department is not spending money as fast as it originally contemplated on our ICBM program, it is also true that there has been no holdback," Rep George Mahon (D-Tex.), chairman of the House Armed Services Appropriations Subcommittee, said.

"There has been no cutback in the program that would be detrimental. We are moving forward at that as is desirable."

Rep John Taber (R-N.Y.), ranking minority member of House Appro-

priations Committee, said "it is not true that Congress or the administration has slowed our efforts."

"The slowdown," Rep. Taber said, "has been in areas where we are putting up staff for a study and where it isn't needed and which will be obsolete shortly. There is not a lot of truth in any allegation that there has been a slowdown in the ICBM program. There has been no economy in the things that count."

Sen Stuart Symington (D-Me.) also charged economy in speeding development. He said it is "almost impossible to realize that then administration has slowed down our effort (on ICBMs) for purely budgetary and fiscal reasons."

Sen Leavitt Schwendler (R-Me.), the administration's top Capitol Hill spokesman on defense matters, disagreed, saying no comparison of the defense program is necessary.

"Without pulling the top off the barrel and having an explosion in all directions, all expenditures or appropriations that could be reasonably substantiated for the ICBM or for missile and development have been made," Sen. Schwendler said. "Our military people have been moving forward as fast as they can and with the prospect in view of guided missile developments by other nations as well as ourselves."

Russian attainment of the missile he said also discussed recent test explosion of nuclear and thermonuclear weapons in the Soviet Union. Nothing in the statement, however, related nuclear or thermonuclear weapons directly to a need for rockets.

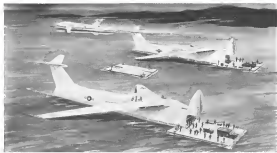
The "major long-distance interests, missile and missile ballistic rocket was launched a few days ago," the Russian statement said. "The test was successful. They fully confirmed the correctness of the calculations and the selected design."

"The rocket flew at a very high supersonic altitude," the statement said. "Covering a huge distance in a brief time the rocket landed in the target area. The results obtained show that it is possible to direct rockets into any part of the world."

The solution of the problem of designing intercontinental ballistic rockets will make it possible to reach remote areas without resorting to a strategic air base, which at the present time is still unable to up-to-date means of strategic attack."

An Force has not been allowed to make any official statement about test firing of the Altus ICBM test firing. Even a statement might be made that the test was successful.

Rep John Taber (R-N.Y.), ranking minority member of House Appro-



WATER based air logistics system built around eight jet Martin SeaMasters, twice the size of PGM, is depicted by artist.

Martin Proposes New Air Logistics Plan

By Event Clerk

Washington—Eighty SeaMaster aircraft, built at a rate based on logistics studies and to be the size of the PGM SeaMasters, was proposed last week to the Marine Corps.

Martin also opened a campaign to the public and congressional documents of what it called a lack of adequate military ability and the "unsustainable" in the way of achieving it.

SeaMaster would have approximately twice the size of the PGM SeaMasters, 151 ft. length and 108 ft. wingspan, a speed of 500 mph and a gross weight of over 600,000 lb.

First generation would be covered by Pratt & Whitney J75 turbojet powered by ducted fan turbofans and four by nuclear engines, all using the same engine.

Funding Plan

Martin and development and procurement could be funded within present budget limits and how funds now being spent for sea and land transport that SeaMasters could replace.

Production could begin within 14 months and cost of production models would be an estimated \$5 to \$5.5 million, roughly that of PGM or B-55.

Each of the SeaMasters fully loaded would be 5.5 ft. Every 100,000 gal of water from the water which could be used by the SeaMasters on an air ability of 15 to 1 over 1000 ft. in 15

minutes with which the U.S. has defense commitments. These could be served logistically by only England, Japan and North Africa were available to SeaMasters from Martin believe.

Water based air logistics proposal was presented as a concept, with SeaMasters as a "tabletop design" comprising the heart of a complete system, including being and ideas for being seen and taken of sea.

SeaMasters is capable of landing in 10 ft. water or on 4 in. of snow and custom designed aircraft plan for clearing sea lanes with snow in transportation down to -40° F., Martin said.

Martin believes 100% of the personnel and 75% of the equipment now shipped by sea should be moved by air logistics. SeaMasters can accommodate light plane of military equipment on-board—New's release claims.

Briefings on SeaMasters concept have been made over past few weeks to military trade associations and defense and transportation sides. Further briefings are planned for higher defense and congressional officials and for shipping companies and industry.

Readbacks

Citing recent congressional testimony on the lack of adequate strategic airlift, including certification of USAF DOD to C-130 project and lack of one F-105 for USAF's Douglas C-119, Martin's advanced design project captain Gen. Milton said three "modular" percent Defense Department from accepting and expediting water based logistics concept.

"Pressure on Department of Defense and Congress from the commercial air lines not to be able" that appears to coincide with claims. Milton pointed out that the SeaMasters would be "four times too large for the airlines to use but the huge economies for military operations." He said it should no longer be designed with commercial possibilities in mind then a tank should be designed to be able to be a tank.

Milton believes 10 SeaMasters could have the same capability of the 500 carriers and military reserve transports now available.

While land based aircraft should be used, to some extent of the water and air-transport routes between water

PGM Tanker

Bethlehem—Bethlehem Steel SeaMaster probe and design relating equipment will be built by Flight Refueling Inc. for Martin Co. and installed on its only model test tank. PGM will be able to transfer a reserve reserve 10,000 gal of the most economical agents and also, Flight Refueling will SeaMaster water tank, which now carries more or more fuel automatically also will take refueling equipment in a 10-minute time door pad.

based aircraft can be used to serve cost but areas where fields do not exist or are destroyed such as a port, and in areas where troops are needed as quickly as there is no time to build airfields.

• **Divided responsibility.** Within the Defense Department, although Army and Marine have great need for airlift and have shown interest in Sea-Mexico con-

cept, Air Force has the budgetary responsibility to provide it and Navy has development, procurement and operational responsibility for seaplanes.

• **Microcomputer on cost and capability.**

Purchase of land-based planes must be superimposed on other logistic needs, Mulloy said. But water-based airlift

would replace "any transport action which cannot survive in peacetime under modern combat conditions"—surface shipping, for personnel and equipment, rail and pipeline movement of all cargo into the combat zone. Savings of \$300 million could be achieved in the Military Sea Transport Systems alone, Mulloy said.

Lockheed Offers C-130B to Civil Lines



PAYLOAD of new Hercules flight included 21 helicopter engine parts, 100 lb. of airborne command-control system (shown above), 2,500 lb. of T38 engine parts, 100 lb. of airborne command-control, 140 tons. Load was lifted from Minotota, Ga. to Indianapolis, Ind.



MOCKUP of flight deck of commercial version of Hercules is demonstrated at Lockheed Aircraft Corp. Minotota, Ga. (left). Component contains two banks, but not pilot, storage space, toilet facilities, sleeping quarters and insulation.

Minotota, Ga.—Lockheed Aircraft Corp. announced today it will make its first bid to enter the rapidly growing air freight market with plans to offer a civilian version of the Hercules C-130B troop and cargo carrier to the airlines as an all-cargo, helicopter commercial transport.

The air freighter, which will be the first commercial plane to be produced at Lockheed's Georgia Division, will be ordered into the commercial market as an intensive sales campaign. Robert F. Stoenes, has been appointed Hercules commercial sales manager.

Stoenes, former manager of sales operations at the Georgia Division, will begin his campaign next week at the 17th annual conference of the International Air Transport Association in Madrid, Spain.

1960 Delivery

Operating and performance characteristics of the commercial cargo plane are the same as in the USAF C-130B (AW Aug 17, p. 58) recently made good in an improved version of the C-119A (AW Dec 3, p. 50). The commercial version will be designated Lockheed's production model 782A. First estimated cost of the aircraft is at the low \$2 million category. The basic data has been set for 1960. The plane will be powered by four Allison 501 D12 turboprop engines rated at 4,350 shp each.

Lockheed's decision to introduce the C-119B as a commercial cargo plane is based on the increasing volume of air freight which the manufacturer now handles almost constantly during the first six months of 1957. Lockheed's commercial backlog, centered in the California Division, represented 29% of the company's total during the first half of 1957.

In its recently published 1958 report, Air Cargo Inc., a corporation wholly owned by the wheeled airlines, said revenue ton miles handled by the carriers had increased from 38 million in 1947 to 434 million in 1956.

The report admitted the majority of air freight moved is the scheduled airline. It is currently handled on passenger aircraft but added that scheduled air-

craft services operated with civilian cargo aircraft are "more flexible in the handling of freight."

Most major cargo offices feel there is a market for a cargo aircraft such as the one being offered by Lockheed. "They point to the trend toward the purchase of larger aircraft by the airlines for overseas cargo as critical of carrying in scheduled C-47s or C-54s."

Both American Airlines and United Airlines are operating DC-6A equipment on all-cargo schedules, and Flying Tiger recently introduced a sharp increase in gross revenues in its new fleet of 12 Lockheed 1049H Constellation (AW Aug 26, p. 45).

Straight-in Landing

Lockheed claims the air freighter is the first U.S. commercial plane to incorporate "straight-in" track and deck-level landing facilities. The aircraft has a cargo floor only 41 inches off the ground and is equipped with an integral landing ramp 11 ft. long and 10 ft. wide. The ramp can be lowered for direct cargo loading from the ground or can be used from docks. Air space up the side of the freighter is 18 ft. wide and 8 ft. high.

A forward door, 6 ft. 7 in. wide by 6 ft. high provides additional loading and all loading facilities.

The plane will have a payload of 22 tons for a non-stop distance of 1,750 statute miles with normal load capacity or a payload of 16 tons on a range of 3,800 statute miles.

Cruising speed of the aircraft will be approximately 350 mph at altitude in 18,000 ft.

The aircraft can be quickly converted to wheel-based operation for field climates and has been cleared as a "high performance" jet high-altitude aircraft. It can be landed into position after its own power and can be turned on its tracks by means of a steerable dual nose wheel.

Propeller Changes

The plane will be equipped with 114 ft. four-bladed propeller instead of the 15 ft. four-bladed propeller used on the C-119A. Fuel capacity is 6,000 gallons. Lockheed feels that the aircraft's cargo will have less damage under considerable operating exposures in the basic first commercial delivery is made. At present, flight hours accumulated on the C-130Bs are approximately 15,000.

Several meetings have been held with the Civil Aeronautics Administration to discuss design features of the new plane. CAA officials have indicated state tests and structural fatigue tests of the C-130A. According to a Lockheed spokesman, the manufacturer expects the tests to provide a good background for the certification proceedings for the 282A air freighter.

Hybrid IRBM Fight May Fall Into Management, Not Technical Fields

By Philip J. Klein

San Francisco—Durrant senior philosophers in the field approach to managing degree battlefield analysis may prove a more serious barrier to evolving a hybrid IRBM than the technological difficulties between the Army's Jupiter and the Navy's Thor. First view is that management of a hybrid program must live by Air and USAF off-rails indicate.

Secretary of Defense's recently formed Interim IRBM committee, which is to develop a plan to coordinate technical leadership of a hybrid "Thorjet," consists of William H. Holden, Defense Secretary's special assistant for guided missiles, Maj. Gen. John R. Mulvaney, chief of Army's Ballistic Missile Agency, and Maj. Gen. Bernard A. Schriener, chief of USAF's Ballistic Missile Division.

Gen. Schriener, an Air Forceman to address the Western European Command, said the Air Force and Army cannot see between the Jupiter and Thor's "hybrid" (IRBM) use. North American Rockwell Corp. president, presentational guidance systems and both have considerable solid rocket guidance systems under development for possible hybrid purposes. Gen. Schriener said. Major difference, according to Gen. Schriener, is in "manipulation." One can easily adjust Jupiter into an existing program. Thor uses liquid fuelled jets.

Secretary of the Army Walter M. Brainerd and Gen. Schriener agree at Winston on separate dies and neither accept a direct solution. The Thor Jupiter, he observed, "is a hybrid" that speaks combined oblique references which point up the sharp cleavage in IRBM development philosophy between the two services.

Jupiter, which Brainerd said is "slightly ahead of schedule," was cited "as a splendid example" of the advantages of the Army's philosophy of development. "It is a hybrid IRBM," he said, "and it is a hybrid IRBM." "There are no doubts to produce." "When we have a project out to industry, most of the personnel... has been eliminated." Brainerd said. "We have a good road to increase acceptable performance. We know within narrow limits what the cost ought to be... how low we should expect delivery."

Then, in a pointed reference to Air Force guidance systems, he said: "There is a philosophy of presentment which advocates contracting out virtually everything and putting upon industry the whole job of determining

what should be supplied. This can lead to false starts, frequent modifications and unsatisfactory and slow. Such procedures are wasteful, costly and time consuming."

Without mentioning Army's recent flights of Jupiter test vehicles, Gen. Schriener said a single or a few shots of a minute but breakthrough follow by an operation on a clearly agreed-upon model ship may be a satisfactory approach to illustrate a principle.

The key problem is to organize the entire program so as to avoid the difficult working out of all engineering details such as design and some by experiment, the attainment of schedule through a great deal of testing, and an industry capability to reproduce the results in the quantities required.

Therefore, he has held agreement in one planning that production and operational capability are the real end goals of the development.

Without making reference to such factors as light, Air Force experts, mental sciences, Gen. Schriener said the USAF must look reasonable in coming to that only a small portion of the total is visible.

"Hundreds of flights may be needed to accumulate a single hour of operating experience," he said. "Advances in proof of reliability can not rely solely on flight tests because of the enormous expense and risk involved in sustained testing. Wherever possible all advances must be brought in a high reliability by testing on the ground."

Gen. of an satisfactory comparison in a hybrid IRBM, which observers believe, is the question of which service would manage the development and whether it would be carried out in Ballistic Arsenal in land-based Army activity or in industry under Gen. Schriener and Ballistic Missile Division. To these observers the problem of evolving a hybrid "Thorjet" appears far more complex than evolving a land and Army Air Force development of management organization and philosophy.

ICBM Defense

Three industry teams have completed studies proposed Phase I study program on possible defense against intercontinental ballistic missiles and three reports are now under evaluation. Contract include: General Electric Corporation, Lockheed Martin, and Douglas Aircraft Co. Telephone: 444-4444 (AW Aug 15, p. 16).



Positioning of Bloodhound's four booster nozzles, two straight at down (top right). Wings stress simplicity.

British Bloodhound Displayed

British Bloodhound guided laser structure having made a point out by two Thor cruise with thrust estimated at 5,000 lb. each. Four solid fuel booster nozzles are hinged at bottom from a common ring (below, left) and an expansion nozzle pair outward from forward attachment point and full behind with wing wing intact (AW Aug. 25, p. 24)



Heat Problems Limit Rocket Fuel Gains

Evolution, II—Heat problems imply "a foreseeable end of the line for chemical propellants" in rocket engines if they are not solved, and similar problems will carry over into use of high-energy propellants, and nuclear-type engines. USAF Brig. Gen. Marvin C. Densler told an American Rocket Society meeting here last week.

Gen. Densler, Air Research and Development Command's deputy chief, markets for R&D, and magnetic fluid dynamics in connection of man's new "longway large on the horizon in the realm of propulsion." He said there are "indications that there might be a useful tool for the ultimate propulsion of a rocket."

Gen. Densler said the work is being done to find a way to distribute the expenditure of investigating basic physical phenomena and its engineering implications of such investigations.

Further work is being done and partial results are possible through continued development of current rocket engine technology, Gen. Densler said.

"But as long as we are dependent on increasing specific impulse, with its attendant problems of combustion, very probable and present, is an additional cost barrier, with the weight of making fluids, the high levels of combustion, the cost of exotic fuels, the need for further understanding of combustion processes and the basic principles by which a best engine operates."

Heat Barrier

Heat, he said, is "one of the foremost barriers" in further development of chemical and nuclear engines. "To make materials which will withstand much higher operating temperatures we must be able to characterize the gas heat loads of the materials and to do this we must explore the basic areas of nuclear sciences."

"Failure in this attempt implies a foreseeable end of the line for chemical propellants."

Gen. Densler said the engine must be in which particles released in combustion flow against walls of the combustion chamber. "A second barrier to optimum employment of chemical fuels."

Researcher found that several particles followed by strong magnetic fields "could be directed and accelerated" so that using these magnetic forces to deflect the particles away from the walls of the chamber, "a controlled heat loss to the walls of the chamber," Gen. Densler said.

Advancing into use of high-energy propellants and the need for chemical propellants in rocket engines if they are not solved, and similar problems will carry over into use of high-energy propellants, and nuclear-type engines.

Ionic Propulsion Research

Washington—At least five contracts for exploratory research into the possibility of using propellant are being sponsored by Air Force Office of Scientific Research. None are being negotiated.

Significance of AFOSR programs is that after three decades of theoretical studies, some propellant now is the subject of active, sponsored research, with attempts being made under some of the contracts to achieve those on a laboratory scale.

Contractors include Aero Motors Engineering Corp., Indianapolis; of aircraft technology, Rocketdyne Division of North American Aviation Inc., Van Nuys, Calif., April 5, p. 27; General Electric and other academic studies at University of Utah and Aeronautics Research Foundation on particle acceleration and high velocity jet.

Other companies that have shown interest in ionic propulsion propellant are General Dynamics Corp. (AW May 4, p. 134) and Aerojet General Corp.

Estimate of rocket speeds attainable with ionic propellant range is high as Mach 3,000 and estimates on specific impulse possible have ranged up to 300,000 sec., but there still is wide disagreement.

Ionic propellant system would obtain thrust by electrostatically accelerating streams of charged particles (AW Nov. 25, p. 37). Drawbacks include need for a great electric power source, but that is less of a problem since there is a long period of time and need for conventional power for operation in earth's atmosphere.

propellants and "the entire type rocket in which combustion happens from any source." "Solving the problems of ion propulsion will bring more information to heat transfer and performance," Gen. Densler said.

"However, discussion, comparison and recombination will create problems throughout the combustion and gas flow cycles," Gen. Densler said.

"Establishing and inhibiting of dissociation, fluid body effects of chemical walls and/or wall coatings or solids that may be possible but a considerable effort in the amount of heat energy converted into ionization energy will be required."

Although high-temperature ionization is not a new concept, "it is not a simple concept," Gen. Densler said. He called for further development of "this type of concept relative to more use of ionization and ionization," but he did not predict progress toward effort and greater exchange of information between scientists and Air Force are needed.

Environmental Energy

In addition to the development of chemical and nuclear engines, Gen. Densler said, "We must explore the utilization of environmental energy, the energy of the sun and the energy of the ionosphere and distribution of wave, stream and low velocity material in the earth's atmosphere" is attempts to harness them for propulsion.

Gen. Densler also said AFOSR's Research Planning Objective Document, which will outline USAF's view of scientific interest to industrial and educational research groups, will be ready

for distribution later this year. The RPO corresponds to the research areas in AFOSR's Research Planning Objective Document in the area of technical requirements and development areas of interest. There will be one RPO for each of the six Air Force Research Program areas—propulsion, materials, weapons, graphics, electronics and communications.

Atom Rocket Engines Studied by Lockheed

San Jose, Calif.—Nuclear propellant for the study in order to gain insight at Lockheed Aircraft Corp.'s Nuclear Systems Division.

Dr. Louis N. Bader, chief general manager for research and development, said a basic addition to the use of nuclear power in rockets will be used in the development of the possibility of nuclear propulsion. The acceleration, largest in use in the nuclear industry, must also operate but such at the Lockheed Nuclear Laboratory at Stanford University's Industrial Park, Palo Alto.

The accelerator produces nuclear in fusion, under controlled conditions, generating energy of nuclear power. Biological or chemical fuels will be used to bombard targets. Dr. D. D. Moffitt will direct the work.

Study to be investigated include nuclear structure, nuclear design, nuclear shielding design and nuclear damage.

The accelerator will be made available to neighboring scientific organizations on a commercial basis. It is the

first of its type to be used on the West Coast. The 2,500 sq ft accelerator room is surrounded by three ft concrete walls. A large pit beneath the target prevents collection of neutrons from the floor. Control room is 100 sq ft. The laboratory also contains a radioisotope work cell and the accelerator room where natural or artificial radionuclides may be removed from containers by remote control to expose materials for study purposes.

Aero Design Facility Destroyed by Fire

Bethany, Okla.—Main production facilities of Aero Design and Engineering Corp. was destroyed by fire last week. Damage is estimated at \$5 million, including seven Aero Commuters which were on the production line when the sheet metal

Acro Danga will shift production work to its new plant, allowing completion of the export from the burned facility. Acro Danga President B. T. Awa, Jr. said the company will conduct business as usual and there will be no interruption in company operations or the manufacture of spare parts for Acro Compressor.

Production facilities will be established on an expeditious basis at the new plant, and the company hopes to start rolling new Commanders out in 90 days. The new building is two-thirds finished and will be completed within six weeks. Anna and Aero Design has 50 acres in its production process.

Senate Group Attacks USAF Procurement

Washington—Procurement of weapons systems through joint contractors damaged much business and USAF has not been effective in its effort to conduct more in plant work. By prime, a Service committee charged last week.

The Senate Small Business Committee acknowledged that USAF is trying to make weapon primes on their own backyard and rely on a subcontracting strategy that includes a fair share of companies employing less than 100 persons.

But, its report concluded, in this and other areas Department of Defense officials "who dictate procurement policy have failed to recognize their contracting and technical personnel that when they publicly state that they want to help small business they mean exactly that."

The committee headed by Sen. John Sparkman (D-Ala.) cited the case of a small business firm that saw its business with the Air Force decline from \$1.5

million in 1933 to \$20,000 in 1966 and to nothing in 1987. The company was told USAF no longer purchased his product and that he should sell it to the prime contractors. Solicitors of business from 85 prime contractors around the nation.

The report said the case "indicates less than wholehearted support of the Air Force subcontracting program on the part of weapon system and other prime contractors."

It was suggested that the Small Business Administration be allowed to approve or disapprove applications for accelerated tax amortization on new plant facilities when these facilities might result in loss of contracts to competing small business firms.

The committee's emphasis on alleged failure of contracting and technical personnel to carry out the intent of their support as protection of small business interests came at a time when protests against this situation are mounting.

Current downturns and cancellations of USAF contracts, feared by Pentagon budget austerity, are creating in most companies from small business firms that prime contractors are being to pull former subcontract work back into their plants. It is anticipated that the situation will get worse as prime manufacturers feel the pinch more severely and are hard with personnel layoffs and various facilities.

The committee stressed that the Air Force survey all its prime contractors to find out exactly what com-

Reds Visit Wisconsin

Visit of 46 Soviet scientists to recent Western Electronic Conventions (WEC-68) in San Francisco, prior to attending International Scientific Radio Union meeting at Boulder, Colo., created significant impressions upon both hosts and visitors.

* Several visitors were deeply impressed by magnitude of U. S. electronics in display, as reflected by the 500 company exhibits and more than 30,000 engineers in daily attendance at Western Air Exhibit. Popular Society prominence is easily verified by fact U. S. scientists, there were no formal exhibits and attendance was around 1,000—many of them engineering students from Moscow University.

SU. S. books were impressed by comparison of existing Soviet scientists and their command of the English language. Although not scheduled to deliver any papers at Warsaw, many of the visitors prepared on the spot and delivered highly theoretical papers in English dealing with information theory, automatic amplifiers (Mazurek) and electronic waves in liquids. Papers were delivered at a somewhat scattered evening session.

Lockheed Layoffs

Total employment at Lockheed Aircraft Corp. will fall from a mid-August total of 64,980 to 54,700 by the end of the year because of aircraft procurement cutbacks, the company has announced. Reductions in force will be brought about by "normal terminations and layoffs." No mass layoffs, however.

- **California Division**, from \$2,000 to \$5,000
- **Georgia Division**, from \$5,000 to \$6,500

- **Reductions** are partially offset by an increase in the Middle System Division from 5,400 to 6,300. The composite mean will increase by 100.

points have been removed from the subcontrast structure. It also suppressed concern over USAF figures showing the amount of prime contracts held by small business firms as of Dec. 31, 1976: only 5568 million, 1.9% of the face value of all USAF contracts.

Also under fire in the report are (B&P) testing methods and alleged non-adherence to published regulations covering Qualified Products Lists. The committee found that "unknown non-plastics" and "sophisticated use" of such things as the DRL and the weighted average pricing formula "tend to thwart small business men and to justify a strong preference for large suppliers through plausible, though unsubstantiated, references to 'purchase efficiencies' and 'technical support'."

House Group Criticizes Boeing, Air Force

Washington—Honeywell Armed Services Committee criticized Boeing Aircraft Co. and the Air Force last week for what it termed failure to evidence "any enthusiasm for or interest in" the receipt of \$5 million more profits on a subcontract with the Ford Motor Co. for B-47 war jets.

General Accounting Office testified that Ford volunteered the refund but that Boeing was reluctant to accept it and that USAF did not properly prime a contract regarding (AW April 5, p. 37). "The position of the Air Force on this transaction is unusual," the committee declared. "35 million of savings scarcely got the credit worth of attention from higher echelons."

Noting that Boeing has protested that this was a misinterpretation of its attitude, the committee commented "It is the severity of the judgement of the American public has been visited upon these parties we think it caused by their



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Resale Market Softens at Critical Time

With airlines facing major equipment shift to jets, prospect of used aircraft oversupply looms.

New York—Traffic airlines, in the midst of their aircraft replacement program, find an uncertain market for their used transports.

What has been a seller's market for domestic turboprops shows signs of leveling off.

Planes are getting a little harder to move, and some prices are off compared to a year ago.

If the market is flooded during the next few years with obsolescent piston aircraft in new jets and turboprops, large savings in quantity, plummeting prices will add to the airlines' financing woes.

Whether this happens or not, the buyers days when airlines can find transport are slipping up at a precipitous rate.

Slower Types

The DC-6, Constellation and passenger twin-engine types that should be coming on the market soon in greater quantities than ever before are still selling high—in most cases, higher for clean and newer than they cost at the factory.

Large multi-passenger airplanes still rarely available, second-hand are further in the favor of the replacement plane.

To dispose of the next round of aging planes, as well as increasing DC-6 and DC-4s, the airlines are going to have to price them more realistically than they have.

As of today, prices still reflect a seller's market. Estimated current top valuations for new twin jets, Constellation and transports, when and if available, were provided by William C. Wolf Associates, New York aircraft broker (see page 18).

Recent for a Stratosphere or 0-49 Constellation are notably scarce. A soft spot in the piston market is the new pressurized DC-4, its obsolescence accelerated by large-scale deliveries of international transports.

Example: • **Slick Airways** has had seven DC-4s in the block for several months without being able to move them. Prices in range are \$100,000 range. Slick plans to introduce a sale effort, perhaps negotiating terms.

On the other hand, Slick recently sold a DC-6A to Alaska Airlines and got a premium.

Slick recently set up a separate division to handle aircraft sales (AW July 23, p. 47).

• **Flying Tiger Line** sold eight DC-6s recently, all of them to foreign carriers. It reports good prices for the aircraft, but worked hard to find the customers through advertising, heavy sales effort, on direct contact is a full-time Flying Tiger representative handling sales of the DC-6s and DC-4s. All C-46s will find a foreign government.

• **Western Air Lines** disposed of its two DC-4s to a British airline. Wolf says not as good the price, but reports a softer market for the DC-4 than for the DC-3.

• **Eastern Air Lines** recently sold a DC-4A, with 6,000 hr. since major overhaul, to Pacific Southwest Airlines for \$163,500.

Softening DC-6 market is still active. Wolf reports sales by his organization of three of these planes within past 60 days, one to a Canadian mining corporation for \$450,000 with about 1,200 hr. since overhaul.

Highest prices ever paid for DC-4s, Wolf says, probably were those paid during 1952 when two went to Japan Air Lines and one to Thai Airways, at prices related to a new time loss of \$750,000.

What the market for used transports will be in the next few years depends on supply and demand. Supply will depend on what the big airlines do with their piston equipment.

If traffic continues sufficiently to absorb most of the new capacity of expanded fleets, carriers can release their older equipment more gradually.

Eastern Air Lines President Thomas Armstrong recently predicted to the Civil Aeronautics Board, however, that delivery of new aircraft requests to U.S. flag air carriers within the next four or five years "will certainly result in flooding the aircraft market to an extent probably never known before and even in the immediate post-World War II period when there was considerable number of DC-3s and DC-4s available."

Plans Formulated

Only Eastern and American Airlines among the Big Four have any formal plans for beginning the retirement of piston transports of present equipment.

• **Eastern** has sold most of its piston aircraft in stages with Calumet Airlines. Eight DC-4s have been sold along with three DC-6s, leaving two DC-4s to be sold. Market for the latter aircraft is still "poorly good," Charles Troesch, vice president-engineering told AVIATION WEEK. Sales began last November, and by this November Eastern expects the aircraft to be sold out.

Eastern is mounting out potential money for its Constellation 749s. French experts to sell them off by next spring when delivery of the airlines' DC-7As is completed. The 749s will be priced at about \$1 million.

As to Eastern's twin-engine Martin 404s, Troesch says the airline will continue to use them for some time, but

Used Transport Prices: Going Down

Prices of used transport aircraft, as of today, still reflect a strong seller's market, but the trend is down. Following estimated top values of used planes with one hour since overhaul, when and if available, were provided by William C. Wolf Associates, New York aircraft broker.

	Top Price	Today	Average New
DC-3	\$275,000	\$215,000	\$205,000
DC-4	150-\$75,000	45-\$475,000	475,000
DC-6	1.5 million	1.15 million	1,000,000
L-049	1 million	700,000	625,000
L-749	1.25 million	1.1 million	1,000,000
E-377	1 million	800,000	1,217,000
CV-240	550,000	400,000	275,000
CV-340	670,000	570,000	575,000
M-202	175,000	210,000	210,000
M-404	160,000	400,000	515,000
C-46	250,000	215,000	

or five years at least. Jensen sees nothing yet to replace the 40th.

Kalish also is considering retirement of its 1149 Super Constellation, but hasn't decided exactly when.

Later disposal of other planes will depend on the needs of the jets and turboprops, in Kalish's view.

• **American** is phasing 18 Convair 440s getting its sales efforts to the corporate market. Nine has not been sold in American applications and, although general interest has been shown, there are no several prospects.

American expects no difficulty in disposing of the ten airplanes during the year.

Price of the 240s is \$175,000 each with newly installed engines, which American says is equivalent to "a bit less than \$150,000" in its own words. When compared with the price of the 140 and other aircraft in this class, the 240 is a reasonable commodity with the market, American says.

American also plans to sell two DC-4s, airplanes which it has in the inventory. American says it is not sure if the DC-4s are sold, American may have a few DC-6s for sale at older aircraft of this type are replaced with specially-configured Royal Canadian DC-7s.

Unsold Aircraft

As of now, it is very possible to predict that all past airplanes which may be available within the next two to three years will be sold, according to American. The market, the carrier feels, will be to flyways considerably to sustain the confidence that all of the planes can be sold.

Amongst total CAB that "while the equipment shortage probably is not yet completely over, contact among producers and the before production of turboprop aircraft will be continuing, more progress at higher speeds will change conditions from a seller's market to a buyer's market with the consequent reduction in price of the aircraft."

What will be the demand for new transports in the near future?

Potential customers for the turboprop aircraft will be in the four major categories, as they have in the past:

- Foreign carriers.
- Domestic feeder airlines.
- Inland and cargo carriers.
- Corporate sales.

Foreign Sales

Sales to foreign carriers—not the big, modern competitive airlines but those in relatively undeveloped areas—offer possibly the best hope for disposal of older American transports. The DC-4 would be a good example.

According to Weide, about half of the sold DC-4 sales in foreign areas would be for cargo use, and the land has been successfully proved that market

since more than 75% of DC-4s now go to foreign carriers.

The key selling to the foreign market, American carriers may have to raise their cash financing terms, which they will be reluctant to do.

French and Eastern would reduce the price of a plane that will be an issue, particularly in a foreign carrier which cannot guarantee by a New York bank.

For all its financing, Eastern might help find customers but wouldn't handle it itself.

Feeder Market

Market for used turboprop equipment serving the domestic feeder market appears to have a limited future. Most local service lines are continuing a pace directly from the DC-4 to new turboprop aircraft, several of the lines already have ordered Fairchild F-27s.

New legislation now being cleared in Congress is expected to make it easier for feeder lines to obtain the new equipment (AW July 3, p. 47).

In American's view, discussion of equipment with local airlines, little as it may be, is expected to meet with some success. American will be extremely attractive to the airlines.

• **Central Airlines** has 11 DC-3s, no plans to buy or sell any new, although more DC-3s may be added on the future. When the switch to new equipment is made, President Keith Kahle says Central will go to a turboprop, probably the F-27. **Continental** and **Mark** are also.

Kahle laid stress on the government loan bill as an aid in financing new equipment.

Kahle said it isn't hard to finance DC-3s, but very hard to get money for new equipment. The reason is because of the poor earnings records of local service airlines. Continental plans large deliveries on same basis of help from Congress, Kahle said.

• **San Jose Airlines** has 18 DC-3s, no plans to buy another this year, but as far as 1973-74 for 1955 delivery. The carrier said it is easier to finance DC-3s than F-27s.

• **Pacific Southwest**, an intransigent carrier, but just bought a DC-4, plans no more buying any. President Ken Franklin believes the carrier is the greatest of new turboprop equipment and will plan this type depends on the economics of a carrier's routes and traffic.

As related to a particular airplane market, there is the price difference. To American, the DC-4 is not as attractive as much as the airplane's newness as age as by the relationship of cost and prospective profit.

At **Piedmont**, which has ordered 12 Fairchild, ordered 12 more. It is moving but not been completed, and

some of the current legislation is viable impetus to Piedmont's financing program, according to C. G. Brink, assistant vice president traffic.

Piedmont considers standardizing Boeing Constables, 340s, new 440s, as Martin Brink and Bert from operating experience of other carriers. Piedmont decided these types could not be operated over its routes without subsidy. The F-27 with 36 seats, three, is expected to break even over Piedmont's routes with a load factor of about 60% and get the airline off subsidy.

Brink emphasized that what might be true for Piedmont might not necessarily be true for another local service carrier with a different cost structure. Piedmont's cost is characterized by metropolitan terminals, relatively little competition, several of the lines already have ordered Fairchild F-27s, short-haul flights, good handling flexibility because of its high wing made it suitable for this pattern.

Load Factor

Piedmont figures on 85% load factor for its DC-3s.

• **Midwest Airlines** operates 11 DC-3s and 11 Constable 340s. The airline paid about \$400,000 each complete for the 240s according to President Robert E. Peck. Midwest operated the Constable with 40 seats at a break-even level of about 50%, Peck said. They are used on the 60% of Midwest's route pattern that Peck says is of a high density nature and competitive with trunk carriers. Other equipment is operated with DC-3s.

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new routes are needed on a pending CAB case.

- **Check Air Lines** plans to launch a new turboprop equipment when it operates, but, none.
- **West Coast Airlines**, Southwest Airlines, Meeker Airlines, and Frontier Airlines have ordered a total of 15 Fairchild F-27s.

As for the all-foreign lines are concerned, trend is toward new equipment. Flying Tiger has leased two 1490H passenger-carrying Super Constables and has bought 10 new 1490Hs. It is buying eight new DC-4s. The C-46 is still providing feeder service for both carriers. Southwest and Western has bought for 10,000.

Flying Tiger reportedly is interested in a cargo version of the DC-7, which would be purchased new.

Where cargo lines in the past have found DC-4s to be most available and then at prices higher than new-type planes, advantages are now shifting to the DC-3s to be their advantage to be, new equipment used prices are down. Second hand aircraft such as the passenger DC-7, even at reduced prices wouldn't offer the operating economy to a single line of the DC-6A.

Financing Trend

Flying Tiger Line reports, however, that it is in no way to finance new equipment in new equipment at a bank. It thinks the price is reasonable.

Major carriers now operating the DC-4 appear to be logical customers for such aircraft in Eastern's surplus 740s, but not at the advanced prices of the past. Underneath of the DC-4 is the contract carrier has been licensed not by its general obsolescence but by government requirement that presen-

Equipment to Fly This Week

Equipment to fly this week for all aircraft carriers, passenger flights.

Financing will be difficult for many of these carriers, unless the price of later-model transports comes down.

Corporate Market

Final report market possibility, the corporations, can be expected to absorb a part of the two-engine used transport supply, but how much is unpredictable. Price is going to be the big factor.

What thinks also difficult to in industry will take one of the current market within the next two years, providing the price comes down to the neighborhood of \$175,000, as that with conversion to turboprop equipment the cost will be around \$200,000.

A broker in the Texas area believes a corporate market for about 25 Convair jet transports in the next 18 months. A Southern California broker says little chance in the eyes for corporate sales of this type of plane. And the greatest demand is for new aircraft designed for corporate use, such as the light-twin Auster West Coast broker reports the same situation.

Corporations have ordered a total of 19 F-27s, financing another one at negotiation for used transports.

The market of used turboprop aircraft also showed considerable strength during recent CAB hearings in the Standard Passenger Fleet Income Case, during which some local carriers asked for a 5% depreciation rate increase.

One aspect of this case concerned a new turboprop depreciation policy announced by the Bureau of Air Operations, which would set up a seven-year service life and a 21% residual value for equipment on calculating profits.

Carriers have been using a 30 to 35% depreciable value, and a Bureau witness Harry H. Schneider, chief rates director, testified as much.

The depreciation allowance which the turbine carrier have been claiming for turboprop engine equipment in the past several years has been little, if any, direct relation to the actual depreciation expense. At the present time, to the best of my knowledge, there is no indication that the market for turboprop engine equipment will change significantly.

Airline Practice

As a basis for this Schneider referred to "the industry's new operating rules" which the value of such aircraft in the next several years," as expressed in the right to price proceeding.

In this proceeding a consultant representing the carriers indicated that "prices for the aircraft in the equipment market are estimated at 80% of the current market value."

Schneider also testified that he had no knowledge from the testimony and records of the industry as to how plans to retire any large numbers of aircraft in the next two years.

Airlines, protesting the recommended board in residual value percentage, showed a gloomy picture of the new leasing. Donald Auerbach's statement and others a brief brief spoke of increasing obsolescence rates of both new and used aircraft.

What will happen, and demand for what will happen will the light twin aircraft market brought on by post World War II demand and the Korea crisis cost?

1



Breaking trail by air for Alaska "train"

Flying above the far north's treacherous snow, Hawley Evans led this oversized "train" carrying radar defense equipment to the shores of the Arctic Ocean. Giving direction by radio, he cleared safe passage over mountains, across steep gorges, between icy lakes in temperatures down to 68 degrees below zero.

"Is that kind of weather," says Mr. Evans, "you really want to be sure of your plane. I play it safe as I can, with Cleveland Aviation Gasoline. I've found that Chevron gives me more power on take-offs than any other that I've tried,

and comes through with all the extra power I call for when I'm in flight. Even so, later said it keeps my engine running smooth."

"Another thing that helps make my flying safer, I'm sure, is RPM Aviation Oil. When we combined standard engines in our shops at Fairbanks, we can tell the ones that have been on 'RPM'—they're always in good shape. It gives us many extra flying hours, keeps things and reduces fuel for the life of the engine. Even when it's gas-bolting to the boiling point, it never breaks down."

We take better care of your plane



1200-10001 1000001 1000001 1000001 1000001

TIP OF THE MONTH

Mr. Evans suggests that planes used in snow country be painted a bright color on top. Silvery surfaces often become invisible against the brilliant white background.



Traffic Rules Cited as Helicopter Barrier

By L. L. Doty

Washington—Helicopter Council of the Aeronautics Industries Assn. says joint air traffic control procedures are extending the development of commercial and air carrier helicopter operations.

In a paper submitted to the Aeronautics Planning Group, the AIA called for new Civil Air Regulations for helicopter flight that would be completely divorced from traffic rules governing fixed-wing operations. The council warned that an estimated 29 million helicopter operations exclusive of rotary flights can be expected by 1965 and said:

"Today's system is incapable of absorbing future rotary-wing demand."

Helicopter Needs

Here are the specific requirements based on the present state-of-the-art for helicopter operations urged by the AIA:

- Special Civil Air Regulations written to meet the unique performance characteristics of the helicopter and to fit rotary demands.
- Low-altitude airspace and airways for the exclusive use of helicopters.
- Self-contained navigation system based upon hyperbolic navigation concepts.
- IFR facilities that will permit safe helicopter operations under varying flight conditions without any loss in airport traffic rate.

The report pointed out that the existing CAR governing air traffic procedures are based on fixed-wing requirements and are not adaptable to helicopter operations. It added:

"Since the flight characteristics of rotary-wing aircraft are at sharp variance with those of the conventional airplane and since the airport and heliport have little in common... the helicopter has been operated under a series of piecemeal restrictions, unable to take advantage of its inherent, superior flight characteristics."

The report charged that data and specifications for provision of an air-to-air and air-to-ground communication system under the present CAR. It accused "federal authorities" of procrastination and said the prevailing "corporate type" CAR causes confusion and hesitation among managers and state officials in approving heliports for helicopter operations by large business and industries.

In connection with air carrier operations, the report said the council was unable to measure accurately the expected degree of downward trend in helicopter operating costs because of present flight regulations. It added that helicopters are being forced to follow certain procedures in accordance with visual flight

rules applicable to fixed-wing aircraft making it impossible to arrive at real cost operating costs that can be expected under a more efficient air traffic system.

The report claimed that the cost of helicopter operations have been subjected to "unjustified multiplier premiums" and added "it is a failure to conclude that later reductions will reflect but more downward trends."

Own Airspace

The report concluded that heliports must operate in their own airspace from which fixed-wing aircraft are excluded. It said virtually all heliport operations will be conducted between altitudes of 500 ft and 2,000 ft; the optimum altitude for helicopter operations without compromising safety. It requested that safety and clearance factors will provide standard aircraft does in avoiding this airspace.

The lower altitude operations, however, will present the use of vertical separation of aircraft in opposite-direction flight, the report said. Altitude limits, it added, cannot be used and control will be conducted on profile flight tracks. The report concluded that such a procedure should "so long be required" and that the "nature of fixed-wing aircraft and rotary-wing aircraft must be studied at all costs in connection with operations and especially within terminal areas."

The report termed present terminal navigation a "transition requirement" in terminal area operations, the council called for a 100-ft lateral separation on each side of a light track, which operation in multiple flight paths in addition, the council wants a 500-ft buffer

area coupled with a 250-ft separation from the nearest obstruction. This would place obstacles between flight paths of 100 ft.

Because approach angles will range between 30 and 45 degrees, the council and terminal approach aids must be developed with capabilities equal to providing accurate position data through out the entire range of possible angles as well as in all possible directions. It added:

"For this reason, the existing approach system of fixed-wing operations cannot be kept intact, modified for helicopters. No modified regulations can provide (for helicopter) the long inflexible procedure established for fixed-wing aircraft."

The council advocated that aircraft air traffic control of high-density heliport operations can be possible making air traffic control procedures but warned that this system is deficient as soon as there is increased flight clearance. Assignment of electronic and maintenance of VFR acceptance rates under IFR conditions.

In this connection, the report called for an electronic monitoring device, probably similar to the Doppler on the Boeing Drees system. It suggested that, eventually, radar is probably the best device to provide a lowering of the airport acceptance rate of helicopters.

The council identified the "critical" difficulties resulting from the use of VHF equipment as low altitude because of the problem in maintaining the accurate line-of-sight. And it noted that atmospheric disturbances and penetration clutter reduced the value of low frequency, in using an electronic monitoring device. For maintenance



Flying Tiger DC-6A Repaired

Flying Tiger DC-6A, damaged in a forced landing on a London airfield, leaves from a hangar at Rockland Airstrip. Service International maintenance and repair team, including and again, including replacement of four engines, most of left-hand and main gear, took about two months.



MAKES ANY PLANE A TANKER

Aeroproducts Ram Air Drive powers new "Buddy Store"—first successful tanker kit



Driven by its Aeroproducts full-flowing four-bladed turbine, this self-contained power unit provides all the power needed for pumps and refs. Ram-air-controlled from inside the cockpit, the entire "Buddy Store" unit can be jettisoned at flight, ensuring full engine performance to the tanker plane.

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tion by VIII, the council suggested the use of ground relay stations but on "planned" that "efforts to overcome these problems must be continuously expended pending further progress in the field of electronics."

The council said the potential of the helicopter will be substantially increased if a self-contained airborne navigational system capable of precision performance without reference to ground stations was to be perfected. It added that the most efficient navigational system for en route helicopter operations should be based on the "concept of area flexibility" to permit circuits and multiple routings in congested areas.

Sales Pattern

The council predicted that the nation's services will no longer dominate in the leading purchases of helicopters by 1965. In 1964, the Department of Defense accounted for 93% of helicopter sales, but the council expects it to account for only 48% in 1965.

The report and annual helicopter sales during the period 1957-1965 will average about 1,368 units per year as compared with approximately 550 units per year during the 1946-1956 period. It added that 70% of unit sales during the next five years will occur 1961-65.

Largest users of new military helicopters by 1965 are expected to be large business corporations, according to the council. By that date, 2,300 corporate helicopters, generating a turnover of \$7 million, tops annually, are expected to be in operation. Corporate helicopters will carry between two and 10 passengers at speeds of 50-115 mph. This will be powered by multiple turbine engines.

Commercial use of helicopters is such activities as aerial photography, crop spraying, survey, forest guard, critical time, etc. is expected to create a market that will result in 3,300 helicopters in the field by 1965. The commercial fleet will generate a turnover of 1.8 billion from annually, according to the council.

Commercial helicopter will be operated at speeds of 65-90 mph with payloads ranging from 1,500 to 3,500 lb. The council also expects single engine rotorcraft engines to equip small helicopters in this category.

Purchase of helicopters by the nation is expected to amount for only 17% of the market in 1965. By 1961, transport helicopters will be powered by turbo turbine engines and will travel at speeds up to 160 mph, with 25-50 passengers.

A total of 800 transport helicopters will be operating by 1967 compared to 50 in 1955, the report said. The council added that "massive expanded program to the development of self-contained navigational aids, the estimated 300 air carrier transport helicopters will, by 1965, generate approximately 6.5 million trips annually.

BEA Traffic Rises But Profit Slumps

London-British Airways Airways reports a drop of 54% in net profit last year despite a 145% upswing in traffic.

BEA attributes reduction in net profit to just a higher cost. The airline also had "lowest level" of traffic revenue rate in company history.

Profit before sharing dividend on capital was \$2,348,291 in 1956-57 against \$3,164,994 for 1955-56, a drop of 19.9%. Capital expenditure during the year increased to \$27,213,100 from \$24,740,000 the previous year.

Total traffic increased to 35,685,423 ton-miles, but the company had sales piled on even bigger jump—39%—on 1956-57.

BEA says two factors explain why traffic fell short of expectations: the credit crunch and trouble in the Middle East.

BEA's gross income was \$67,855,765, compared with \$50,478,181 the previous

year and \$31,511,490 in 1947-48, the company's first full year of operation.

Other statistics reveal load factor 64.5%, up 2.1%, revenue passenger miles 333,872,626 up 14.1%, available ton-miles 1,150,792,379, up 12.5%, passenger load factor 70.5%, up 1.5%.

New Bar Floodlights Slated for Idlewild

Washington—Civil Aeronautics Administration will begin installation of new fluorescent bar floodlights on the terminal runway at Washington National Airport on Nov. 1 and start installing them shortly thereafter. The lighting fixtures and lamps are being provided under a \$45,660 contract with Schaeff Electric Products Inc.

The new floodlights will be located on the south end of the runway and will extend 200 ft from the threshold and extending 1,500 ft south. They will be installed on both sides of the runway.



Aeroflot Crash Buried in Pravda

Moscow—Soviet press, faced with the new problem of reporting Aeroflot crashes as disasters, said, apparently has adopted a policy of omission in Pravda.

The crash of an I-14 transport into Copenhagen harbor on May 15 which killed all 25 persons aboard (airways and 12-hour Moscow newspaper daily, Pravda and Izvestia) both times were passed in small type and buried at the bottom of the last column of the last page.

The newspaper account was captioned "Air Crash."

It read as follows:
"On the morning of August 15, a USSR Aeroflot I-14 crashed while preparing to land at Copenhagen's Kastrup Airport. The crew and 15 passengers including one Dutch, two British, and American, six Swiss, two Germans and two Soviet citizens, were killed in the crash. Cause of the crash is being investigated."

Aeroflot's domestic crashes still are not mentioned in the Soviet press, so that the accident statistics for the airline is known to foreign reporters.



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Now you can enjoy the incomparable luxury of Western's world-famed "Champagne Flight" all the way to Mexico City! Reserved seats, gourmet dining, vintage champagne and orchids for the ladies—at no extra fare—will make your flight to this friendly and fascinating country seem all too short. No longer do you have to change airlines. Now you can enjoy America's smartest air service all the way to Mexico City on Western Airlines!



WESTERN AIRLINES

SHORTLINES

- **American Airlines** will begin new heavy service on Douglas DC-7N, between New York and Chicago on Sept 5. The new flights, two round trips each, will be scheduled to leave both New York and Chicago at 4 p.m. and 5 p.m. with a 55 exchange for the flight. On Sept 5 American will begin Douglas DC-6 commuter flights between New York and Boston with three non-stop flights daily in each direction. On Sept 13, the schedule will be extended to include Washington. The DC-6 flights will replace its supplant current Convair on the route.
- **Allegheny Airlines** will resume scheduled operations to Jamestown, N. Y. on Wednesday. The Jamestown Airport has been closed since May for repairs.
- **Pan American World Airways** has opened a telephone tie line between Miami and El Paso to speed continuing conversations. Using the former code words from the latter airline had to radio receivers' control in Miami when continuing conversations were made and a second radio message sent back to Miami. With the new telephone tie line, an agent makes the connection himself.
- **Air Cargo Inc.**, whose stock is held by 25 airlines, reports that its freight coverage in the scheduled airlines has increased in the past decade by more than 1,000%. Most of the increase was attributed to a nationwide agreement between Air Cargo and ground haul services whereby the latter delivers to and from airports. Since 1949, the number of air freight shipments handled has grown from 105,000 per year to 1.2 million in 1956.
- **Bozell Airways** has delivered a dividend of 15 cents per share payable to shareholders of record as of Sept 6. The airline reports that increasing sales in 1957 have closed the gap between sales and added capacity on domestic routes. On international routes, Bozell and sales have exceeded added capacity. The result of these developments has been an increase in net income. For the period ending Feb. 29, net income was 1.2% better than last year's despite a \$1,240,000 increase in depreciation charges. Non-operating expense for the period increased 113%, leaving net income for the first six months of 1957 slightly behind the same period last year. This was due mostly to additional interest charges. Bozell completed in 1956 the full financing necessary in connection with its new aircraft program.

AIRLINE OBSERVER

- **Aerovias de Mexico** will encounter no delay in introducing the turbo-prop Bisturam on its Mexico City-New York route approx. last week. Its President Linderoth is with Northeast Airlines. Northeast has been invited by Civil Aeronautics Board's action to grant it a waiver as landing gear "practice" requirements (AWJ July 1, p. 47). Board ruling that Northeast meet comply with type certificate provisions calling for the proving characteristic before the Bisturam is placed into scheduled service is delaying the introduction of the turboprop transports on Northeast's routes. However, the ruling will have no effect on Aerovias' operations of the Bisturam which is begun to operate this fall. The Board has held it will accept type certification of aircraft operated by foreign flag carriers into the U. S. when approved by the nation's government.
- **Ghana** has received proposals from KLM Royal Dutch Airlines to establish a Ghana airline operated jointly by Ghana government and KLM. According to sources in Accra, proposals call for direct service between Ghana, United Kingdom and other European countries. KLM has agreed to train ground and air crews of Ghana nationality. The new nation's Ministry of Communications is said to be moving KLM officials to discuss the proposals.
- **Curtis Wright** president Ray Hickey and a party of company executives have been in France talking to Sud Aviation regarding the use of the Wright TP38 turboprop engine as a powerplant for the Conquest jet transport.
- **President Eisenhower** has approved renewal of KLM's foreign air service agreement to operate between New York and Amsterdam and between the Netherlands, Antwerp and Florence. The President also approved KLM's new routes to Houston and from the Antilles to New York.
- **American Airlines** July cargo shipment from Mexico was greater than almost any for the first time since the airline began cargo service in Mexico in 1948. During the month, American moved 179,000 lb. of cargo out of Mexico compared to an annual figure of 315,610. The surprising turn spotlight the growth of Latin America cargo business.
- **Fokker** is making good progress on construction of its 20 passenger MD-12 transport (AWJ June 17, p. 77), according to Bessie Stevens. Equipped with four, 193 hp. engines, the MD-12 will have a speed range of 166-180 mph. It will be able to use shorter runways than current Fokker transports.
- **Miami International Airport** is forecasting a passenger total in excess of 5 million during the 1957-58 season. During the 1956-57 season, passengers sent through the airport, an increase of 15% over the same period last year. The 1956 passenger total was 3.5 million.
- **Town World Airlines**, never missing an opportunity to plug its international service, has started a steady stream of new VW vans, plus a plane, to arrive personnel on French and buildings in Europe where the phrase "Yank go home" has been scribbled.
- **Wallo Flom**, former public relations vice president of the Air Transport Association, has been elected vice president of the New York, New York, and will receive his new duties next month, working with Rex Smith, vice-president-public relations.
- **Witch** has the transfer of some short-haul routes by the Canadian government from Canadian Pacific Airlines and Trans-Canada Airlines to smaller airlines apparent. CPA is known to be planning the abandonment of some of its domestic routes as a result of developing its overseas service. Recently, Trans-Canada Ltd. was granted two routes operated by CPA from Winnipeg to the northern Manitoba mining regions and from Winnipeg to Churchill on Hudson Bay, a great Canadian-U. S. defense and re-arming base.
- **Japan Air Lines** will increase its weekly flights between San Francisco and the Orient from five to seven next spring, according to Tetsuo Koyama, vice president of the airline for the American region. The increased schedule will be made possible by the addition of four DC-7Cs to JAL's fleet.

The new pride of Eastern... PROTECTED BY SINCLAIR

Latest Eastern Air Lines plane to bear the *Business Golden Falcon* name is the Super G Constellation. This new star of the skies carries 70 passengers — has an increased cruising range and includes 107 new design features. It embodies new luxury, style and comfort — retains its traditional dolphin-like grace and ample tail.

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WEIGHTS are stacked on loads for quick reference. S-55 approaches camp to pick up load.



NATIVE standing by and took protects men from some of S-55 leaves for drill site.



PRICED and starting is hoisted onto hovering S-55 (left). Ground crew (right) unloads S-55 at Port Moresby after one top-down U.S. Helicopters were sprayed with plastic for protection of sea and forest two S-55s delivered went through typhoon without damage.

Helicopters

By Robert Farnell

Pass-Hover helicopters are significantly better and cheaper than conventional ground methods in oil drilling operations and exploratory work in the New Guinea jungles.

Taking over the prime job of shuttling men and heavy drilling equipment between scattered jungle sites three Sikorski S-55s flying in New Guinea have done in a few months what normally would have taken 18 by moving on helicopters, oil companies have been spared the trouble of building costly roads through dense jungle. Oil companies have discovered they can strip up their exploratory programs in jungle areas in a matter of weeks before thought possible.

The New Guinea operation, launched last March in Papua, clearly demonstrates the potential of helicopters in areas previously costly or impossible to reach by ground transportation.

Inaccessible Terrain

Perhaps what is most significant, helicopters are permitting companies to public planning and areas located in jungle terrain accessible only to experienced men. Already carrying such names as "Tigerhook" and "Haley," the S-55 New Guinea operators believe it might prove to be a major breakthrough in one of the oil industry's toughest problems: how to get its heavy drilling equipment in and out of inaccessible areas.

Credit for doing the spade work in adapting helicopters for oil hunting tasks in jungle areas primarily goes to World Wide Helicopters Ltd., Honolulu. Hawaiian Helicopters Ltd. As the old

Overcome Terrain in Jungle Oil Search

name suggests, the outfit is a Hawaiian corporation though headquarters are in Paris. Most of the top posts are held by Americans although 90% of the employees are of varying nationalities.

World Wide has been working on contracts with oil companies since 1952 both in the South Pacific and elsewhere. Much of its work, a static or less one, is to shut down down in the U.S. In conventional helicopter units working for oil companies, (AW Dec. 31, 1956, p. 27) but recently World Wide has developed with the oil companies its own use of operations.

In addition to the new facilities of transporting skids and other heavy, portable, work gear, equipment and supplies for which Bell 47Ds and Westland-Sikorski S-55s are used—World Wide's three S-55s are looking into the jungle of the equipment and personnel needed for an entire drilling operation. The seven S-55s are carrying drill rig sections, disassembled well-down, as well as a variety of other heavy oil drilling equipment never before lifted by helicopters. To do the job, World Wide, together with its

ad company, contractors, have worked out special rope handling and basic techniques which are designed to offset the S-55 as much as possible in a strong wind.

World Wide checked its approach on the use of helicopters for landing drilling equipment after an earlier so-called "successful" test. The company, under an experimental contract with Royal Dutch/Shell, on details to carry out what turned out to be the first air-lifting of an entire drilling operation.

Drilling Site

Westland S-55s were used in the job which took place at Seong, Netherlands New Guinea. The drilling site was located in dense jungle, about 16 miles from the coastal strip. Here Shell estimated it would take 12 months to build a road through hilly terrain, swamps and another three to dig in the drilling equipment. Two S-55s did the job in six weeks.

Since the well eventually was abandoned as "dry," Shell undoubtedly was relieved it hadn't invested huge

money building a road into the site and spent 15 only, months on a well-pipe drive. Hence the term "successful failure."

The Seong system also demonstrated that the S-55, with its 1,500 lb maximum payload, now too light to be used as standard equipment. Finding this created a demand among the oil companies for heavier rotary-wing aircraft. World Wide just left made its first public show, allowing to discuss the purchase of the three Sikorski S-55s and plans costing in excess of \$1 and here.

With an 8,000 lb payload, the S-55 agrees to fit the machine requirement. This consists of lifting sections of a National 50 oil drilling rig which put fit under the S-55s maximum payload. A National 50 rig, normally drilled down to 15,000 ft, fits on the majority of oil sites. The next size of rig, the National 100, at its present might could not be installed in sections by a helicopter with a payload at least four times that of the S-55.

Am L. Smeethers, World Wide, executive vice president, feels that oil



LEAVING base camp (left), S-55 starts for drilling site to deliver a load of lumber. Skid for drilling rig sections is set into correct position for unloading by ground personnel (right). Helicopters can place some equipment in proper place by assembly.



COLE SWITCHES
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(Illustration courtesy of Lockheed Aircraft Corp.)



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operation such as port little head to weight but that is the reason we will tend to design their equipment with an eye to its being utilized in helicopter. At the same time, the S-38, or other helicopters in its payload category, won't be obsolete for oil drilling operations for some time to come.

First two S-38s went into service in Japan on March 8 of this year. The third joined the regular operation on June 5. World Wide is using three under a contract signed with an oil group jointly controlled by British Petroleum Co. and Standard Vacuum Oil Co.

It runs for 15 months, at which time it continues as lease under for another 90 days unless by either party.

World Wide is paid \$50,000 monthly

for the S-38 work. Standard Vacuum assures the company's profit margin on the contract at 20%, about average for World Wide. Although no lease contracts the profit margin has reached 25%. In general, the Japan operation works in the following manner:

Seven parties are first transported over the jungle region by Bell 47Ds. For this service the oil companies pay World Wide under a separate contract 5 months fee of \$12,500. World Wide uses three Bell 47s on the job, two being with one Bell in reserve. On the basis of reports by the survey team the oil firm then select area for drilling.

In Japan these units usually range from 15 to 25 miles from the nearest navigable river. On the river bank a large area is cleared and a camp established. Library supplies and equipment



Dutch Floots on Jet Copter

Small Kolibri emergency helicopters is shown salvaging reliability skills at its new vinyl chloride rubber boots developed by the manufacturer, Nethelands Helicopter Industries N.V., Rotterdam, and produced by RPD-Holland, Ltd., Rotterdam. Kolibri's two 50 hp engines provide sufficient power to permit copter to lift twice its weight. This has under its several specialized versions of the water ditched with 40 ft. spray lances. It has also developed a "Hibon" speed indicator on which the Kolibri lands and takes off and was for rescue transport.

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Passenger door seal (left) and galley door seal (right) are produced by CHB for the Boeing 707. Materials: High tear strength silicone rubber reinforced with DuPont fabric. Results: tear, abrasion, ozone and weather resistant seals, non-clogging, flexible at extreme temperatures.

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are lashed up the river to the box cove landing. In Papua there are about five of these river box coves.

Aerial bridges between river coves and Port Moresby, 200 to 600 miles distant, depending on the location of the river cove, supplied by a World Wide owned and operated PEY Cat-lifts which is equal to every 21 passes give in conjunction a configuration of 5,000 lb. of cargo the latter resulting possible load to aerial cove. At Port Moresby, World Wide maintains permanent living quarters, supply and storage depots and complete facilities for repair and maintenance work.

Base Facilities

In cooperation with the oil companies, World Wide sets up extensive repair and maintenance shops at each river base camp. Thanks in part to the huge amount of equipment logged aboard by the oil drilling companies, World Wide has loads of S-55 maintenance work, including major over hauls, right in the jungle. Engines are sent out. Complete machines are completely sent back to Port Moresby, with components in repair but this is done to get them out of the jungle, not because the same work couldn't be done at the river camp.

The company also has plans and machinery for the S-55 operation. Plans fly alone and work in a rotation basis with three working and three pending at Port Moresby with their families.

At the river "bushbush," a large shed is constructed to house all the material shipped so be lost. Near the shed is other building is constructed, usually consisting of an open level, into these huts are raised by crane from the shed all the loads to be lifted by helicopter.

The loads are arranged into "pods," not exceeding the 5,000-4,000 lb. maximum payload. The weight of each load is checked, marked on the package in white paint, but as a final check, a scale on the crane again weighs the load while moving it into the bay. Loads are stacked in the bay in this order in which they will be loaded at the drill site.

Skullie Service

Once the "highback" operation begins, the S-55 shuttles back and forth between the bay and the drilling site. Generally, the S-55 makes enough fuel to make two to three trips before having to refuel. Once the drill site is sent up, the helicopter again has shut down. Supplies are maintained and drilling work continued by air as a final schedule. In the final phase, the pack gathering area is all the equipment is air-lifted out.

Before any living between river camp and drilling site begins, safety

FASTENER PROBLEM



New weight saving line of stainless steel locknuts for temperatures up to 800° F.

New aircraft design contemplates speeds of Mach 5 and 6, remote designs push further ahead into the unexplored problems to be faced at speeds of Mach 5 and 6. Projected skin temperatures go higher and higher and in many cases pass the point where aluminum performs satisfactorily. As a result stainless steel will be specified for many of the new generations of fighters and missiles.

Fasteners, too, must be upgraded to meet the special requirements imposed by these projected speeds and higher temperatures. ESN's solution is a new line of Type 305 stainless steel nuts designed to perform efficiently at temperatures up to 800° F., above plated to ensure consistent locking torque, freedom from galling action and a high degree of re-usability.

The new 70LH series is significantly lighter than the type of fasteners previously available for this kind of application... 30% lighter in some cases... in others as much as 60%.

Configurations in the 70LH line include the one and two lug, fixed and floating type anchor nuts, corner mounting type and long threaded nut strips, most of which are illustrated above. Thread sizes available in the anchor base for such configurations are 6-32, 8-32, 10-32 and 1-38. These sizes with the exception of 6-32 also are available in the gang channel nuts.

Like all ESN's Strip nuts, those in the new LH series are self-locking, vibration-proof and high stress is guaranteed.

NAME COUPON FOR DESIGN INFORMATION



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- ☐ Detail drawings of new 70LH ☐ How is a drawing of our product what kind locking feature would you suggest?

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crisis in cost to the drilling site. This clear an area at the site just big enough for a 5/8 to land. As a precautionary measure, emergency clearings between the air camp and the site are located out of the path of attacks of two sides. This a pilot is over some three a few minutes later a landing area.

Last piece of equipment to be installed to the drilling site is a 25-ton DT type Caterpillar bulldozer. The Caterpillar company has worked out a push-pull arrangement on the DT which enables it to be broken down and air-lifted by a 5/8 to 15 tons. Chais in the air, the bulldozer is quickly assembled and clean the air for the rig and further buildings. Moreover, the 5/8 fits in the equipment and supplies needed.

Old companies have discovered that the 5/8s fit in the equipment and supplies most often first had been in tropical. In fact, the 5/8s can move the cargo faster than it is needed. This permits a 5/8 to work in some three one, one at a time.

Supply Volume

Once a drilling site is in operation supplies for two weeks are estimated. World Wide has found that two 5/8s can set up a complete drilling operation, including the movement of between 75 to 1 million pounds of cargo within 10 to 15 days. This is faster than needed, the usual time being passed at two weeks.

Since the 5/8s in Papua New Guinea is operation less than six months, it is essential rules to guarantee its use. Since the use of the 5/8s potential can be realized even so, what has been achieved to date. The average flight between air camp and drilling site has been 15 mi. Average payload is four, which all three 5/8s, one, one, one, worked out to 3,000 lb. On a busy day, World Wide officials say, two 5/8s can carry 15 loads at an average payload of 3,000 lb. One pilot flying 5 lb and 40 tons, loaded 90,000 lb of cargo in a drilling site. Also, recently, a team of two 5/8s carried 75,000 lb in one morning to a drilling site located 12 mi from the air camp. The type of cargo loaded by the 5/8s covers an impressive range of equipment and supplies. World Wide officials say, 90% of these loads are things as technical. Cargo includes broken-down cars, antennas and bulldozers, lumber, fuel, cement, pipes and a variety of other equipment special to drill drilling operations. The heaviest piece of one single equipment existing probably is a 24-ton truck, which weighs 9,500 lb, is 10 ft deep, 10 ft wide and 10 ft long.

World Wide 5/8s pilots have discovered that heavy but compact loads like a road truck are not as difficult to sling and fly in lowlands of pipe, which

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MODEL 476, 170° over to ANS 16402
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0 to +1000°C Exhaust Temp

MODEL 178 dual, 170° over to ANS 16401
—50 to +300°C Cylinder Temp (AN 16401A or T1A)
—50 to 300°C Bearing Temp
0 to +1000°C Exhaust Temp

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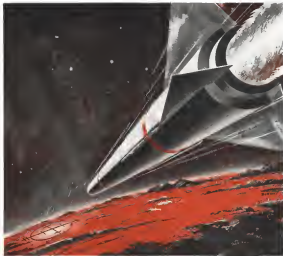
Accurate resistance-type LEWIS indicators are remarkably free of voltage error, have nearly linear scales (not crowded at the ends) and are magnetically shielded. A few typical ranges are given below. Not shown is Model 468, 244° range.

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—50 to +100°C Air Temp

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as long as 60 ft. or other lengths. Both the hammer and steel grader loads at this latter top have a ton apiece, to rotate or oscillate while in flight. Pilots continue to an odd feeling upon seeing a load of piping arch like the head of a duck, drop into, through their doors and van down the ratchet.

Flight maneuvers have been worked out to correct such upward movement of cargo by flying a pattern which can be described as a series of loaded runs, pilots are able to keep the cargo more or less in line with the aircraft. World Wide pilots first, gone further by developing approach maneuvers which result in turning the cargo if need be, to fit it in the correct ground position. When flying in all way sections, S-55 pilots are often able to hover over the work area so that the new section can be placed to the rig and bolts fitted without an need for ground personnel to traffic the section into place.

World Wide S-55 pilots believe they have encountered something new in helicopter flight phenomena, something which Robert Wilson, World Wide helicopter pilot and aerial search operations manager of the Tigua job, calls "phenomena." The phenomenon has been experienced by World Wide pilots on both the S-55 and the S-55 while carrying loads. Effect of the "phenomena" phenomenon, if it is not corrected, is to make control of the helicopter nearly impossible because of severe vibration and rolling. Wilson told Aviation Week the problem has now been solved by the development of a flight pattern which tends to minimize the phenomenon. World Wide pilots are often able to anticipate the phenomenon and correct immediately.

Load Jetstream

An example was the case of World Wide's task, accident where a load had to be dropped in order to avoid a possible accident. During the "successful" operation, Wilson was flying a World Wide S-55 with a 35 ft. 5 lb. heavy ring. The S-55 was at 1,500 ft. and making 10 kt when it began to vibrate and oscillate. Wilson says the phenomenon starts as a small vibration which intensifies until the aircraft is rolling in as much as 30 deg.

"You can't control it by conventional corrective procedures," Wilson says. The correct device is to "just can't cut and the instrument panel."

Unable to regain control Wilson continued the 1 hour into the jungle. Immediately the S-55 assumed normal flight characteristics.

Wilson says on one is possible that what hangs on the rope. It can occur at any altitude and at any speed. Pilots guess it is brought on by a con-

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¹ Gifford, *Islands*, 199, 200; see also Gifford, *Islands*, 199.

⁴⁴ *Amphiprion melanopus* = *A. melanopus* + *Amphiprion* sp.



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AERONAUTICAL ENGINEERING



LOCATION OF PUMPS and oil cooler as shown in front (left) and standard view of Spectre. Oil-pump is on front

Safety, Long Life Claimed for Spectre

London—Additional details of the five-cylinder Spectre motor engine, a variable thrust unit designed for military aircraft, have been revealed. Spectre is firing in the Saunders-Roe S.R. 17, a novel powered research aircraft whose turbojet engine is an Armstrong Siddeley Viper.

Safety Stress

De Havilland says the Spectre is a safe, reliable aircraft engine which can be run reversibly for short or long periods of time and which is absolutely capable of long life.

The Spectre employs turbine as a fuel and high test hydrogen peroxide (HTP) of 81.87% concentration as oxidant. It is a lightweight unit 56.5 in. in length and with a maximum diameter of 32 in. with maximum and 26.5 in. without. Maximum thrust of the en-

gine is 5,800 lb. This can be varied from 10% to 100% thrust by a cockpit throttle.

Engine can be shut down and restarted in flight.

When operation of the Spectre commences in its forward section the turbine which drives the two centrifugal compressor pumps. Just aft of this is the combustor chamber, followed in the rear by the turbine and nozzle assembly.

The small high-speed steam turbine driving the pumps is started by a separate pressurized supply of hydrogen peroxide. Decomposed products from this drive the turbine and then exhaust directly through the main combustion chamber. After the engine is running, HTP is bled from the main peroxide system to supply the turbine. Due to the internal exhaust arrangement, there is a low loss system which has only a

slight effect on the mass flow of the main propellers jet.

The pumps themselves, together with their governors are mounted ahead of the main mechanical structure, with the fuel pump on the port side and the largest coolant pump mounted on the front of the engine.

Control Location

Oil pump is under the gearbox, with a fuel cooled oil cooler on the standard side. Majority of control valves and linkage systems are located on the port side but the HTP control unit is on the opposite side.

The Spectre is an integral unit with oil, electrical and other attachments to the aircraft requiring little more than connection to the propellant tank and linkage of starter and throttle linkage. Thrust acts on the center section of



CONTROL VALVES and linkage systems are on port side for most part (left). Their control coils of the engine (right).



Vertol Demonstrates V-44 to Oil Industry

Petroleum industry representatives were recently shown Vertol V-44As in scheduled capabilities in New York, including lifting and placement of heavy pipe, ad-hoc cargo and crew, prior to loading it on one of offshore oil rigs. V-44As, now in production at Miami, Fla., sells for \$170,000, 14 passenger variants at \$294,000 with deliveries in 60-90 days.

the main structure are not cooling loads but are for strengthening.

HTP is ducted from its pump through a fuel pipe on top of the engine aft to the combustion chamber and nozzle where it is used for cooling before flowing into the catalyst chamber.

Since the flow of HTP varies with throttle setting, this cooling system provided one of the most difficult development problems on the Spectre, which operates at 3,160°C. It was solved by diverting a flow to particular critical areas during lower thrust operation.

Other particularly troublesome problems involve the de Havilland Ekycase Co. engineers' scheduled development of a combustion chamber which would provide suitable mixing, aerodynamic development of pump drives and gear boxes, and testing of HTP in its low pressure to internal jet mixing with oil, as especially difficult task in the pump

area is required from a centrally located nozzle outward into the surrounding combustion chamber. This assumed spray sprays thermally.

Motor rates of HTP to heretofore at 4:1 is constant throughout the entire thrust range.

By decomposing the pressure point in its supply into the combustion chamber," says de Havilland, "the smooth injection of the fuel is obtained without the use of a spark or glow plug and as a consequence free of the hazards of most types of rocket engines, the danger of a hard or explosive light up is completely eliminated."

At the low end of the Spectre thrust range the engine often with 100% thrust from the HTP alone. This provides an added safety feature since during start-up and shutdown, the pump of atomizer chokes out the combustion chamber, delivering any thrust from an accumulation of fuel.

Use of silver in the catalyst can be detected from the colorless exhaust of the rocket engine. At low thrust, stress is applied from the nozzle and as thrust is increased after operation, an oxidant flame appears, showing the distinctive diamond shaped pattern of a hot supersonic jet stream and varying in length up to 10 ft.

Byproduct catalyst conversion used in the Spectre has the advantage that combustion at other than the correct stoichiometric ratio results in lower rather than

higher temperatures. Thus, the engine is running at its hottest when the stoichiometric ratio is correct and any significant mixing results in "cold" spots in the combustion chamber rather than "hot" spots.

Variable Thrust

De Havilland says that in designing the Spectre the requirement for a variable thrust output could have been met by employing a multiple combustion chamber configuration providing its component variations in thrust. But the single chamber providing a continuously variable thrust output and a high combustion pressure was chosen although initially it offered more development problems. However, for example, one can be in the neighborhood of 125 psi at 5,000 lb thrust.

In meeting the problem of cooling the combustion chamber and nozzle, water cooling was tried first. The engine ran under its own power for the first time in July, 1955—two years after the Ministry of Supply placed a contract for it.

It was run "cold"—i.e., at 600°C on hydrogen peroxide only—during the following month. In September, of that year, it was run "hot" for the first time. The Spectre attained its design output in July, 1954, and three months later the water cooling system was discarded as a large step forward as far as design problems were concerned.

There followed an intensive develop-

ment period when both "cold" and "hot" runs were made with only the original HTP cooling system, a period marked by large numbers of burned-out combustion chambers. But as an example of the long engine life was achieved, the engine after a continuous Spectre run of 70 minutes, in which the burning factor rose to consumption of HTP.

The engine flew for the first time in December, 1955, at a New Bedford, Conn. The Spectre in this installation was mounted aft of the rear main bulkhead, with a large payload tank, control on the bomb-bay.

Flight Test

First "hot" test of the Spectre in flight was made in January of this year and a flight test program is underway to place its handling and performance characteristics over a wide range of speeds and altitudes.

This program will be supplemented by a second Canberra now being pro-

duced to carry a Spectre. Flight tests of the Spectre also are underway on the S.B. 11, which made its first flight in May.

De Havilland chose hydrogen peroxide as propellant for the Spectre over liquid oxygen and nitric acid for a number of reasons. Liquid oxygen, with a very low boiling point and rapid evaporation, was rejected as unsuitable for use as an interstage aircraft which is quiet without engines for long periods and also because of the difficulties in dealing with its extremely low temperature. Nitric acid was discarded as unsuitable for a manned aircraft due to its highly corrosive and toxic nature.

Despite the fact that it is expensive and requires special handling due to its non-propellant characteristics, HTP was selected.

One of these was, in fact, considered an advantage. Since it contains energy of its own which can be released in a catalyst, HTP could be decomposed into steam and oxygen for driving a turbine.



First Whirlwind Mk. 7a Delivered

First batch of Westland Whirlwind Mk. 7a fighters, first to be built in England specially for amphibious warfare, are being up as an aircraft at Yeovil after delivery to Royal Navy. Powered by Alfa Romeo 1250, it is already built under license.

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For complete information and specifications, write Bendix Radio Division, Aviation Electronics Products, Beltsville 4, Md. Or West Coast—10950 Magnolia Blvd., North Hollywood, Calif. Export—Bendix International Division, 285 East 42nd Street, New York 17, N. Y.

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De Havilland turned this to advantage, just as it did the fact that HTP drives piston engines. Ignition was high enough to ignite fuel which could be exposed to heat with the engine released.

Kaynes was considered the obvious choice for last year it would already be available as a named powerplant model.

"At the same time, no longer is required if possible and had no radioactivity emitted outside the rocket engine's combustion chamber," and an official of the de Havilland Engine Co. "With the Spectra system installed, we feel we have retained all the combining advantages of self-igniting fuels such as the Germans used in the ME 163 and the French jet still using as the T-108 without incurring the serious risk of an inadvertent fire or explosion if they accidentally mix."

Starting System

The fact that the pressure and temperature generated as part of the decomposition reaction can be harnessed to provide both an engine starting system and an auxiliary drive system (as an engine auxiliary system can be provided without any secondary power supply).

Reduction of cooling problems as a result of the relatively low combustion temperature of the peroxide motor is cited as an advantage. In the case of the liquid oxygen rocket, de Havilland

notes, cooling is a major problem, so much so that in the need for lower temperatures fuel/oxygen mixtures for the optimum are likely to be used, reducing the efficiency of the motor.

"The oxygen motor has to recognize its own special problems, for more valves and an electrical system with spark plugs and micro-switches, quite apart from a separate source of energy for the various auxiliary systems," the company adds. "Furthermore, it is obvious that if one has a liquid at -180°C in an engine then suitable precautions must be taken to ensure that controls, valves, etc., do not freeze-up during a working period."

HTP Disadvantage

Though during this liquid oxygen, HTP is not as close to liquid as both these other fuels also have the advantage of being much cheaper than HTP. One of the biggest disadvantages of HTP is the fact that must be taken to prevent it from coming in contact with any of the many catalytic agents which will react to it.

De Havilland since 1945 has been advancing use of liquid propellant rocket engines as a means of providing powered aircraft with a rapid rate of climb and quick acceleration to maximum speed, as well as maneuverability at extreme altitudes.

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design and development of a variable thrust screw-in rocket engine, de Havilland's main project in the field had been the Spirit assisted take-off unit for the Comet 1. This was a self-contained unit using HTP in a screw propellant, supplying it from a compressed tank which was an integral part of the engine.

De Havilland's SuperSpike, developed from the Spirit, was an ATEC unit which used kerosene with the HTF to enhance performance. SuperSpike employs turbo-propellers with a stringer to lance the propellant into the combustion chamber. It provides 4,000 lb thrust for 40 sec. SuperSpike was in production for the Vulcan Valiant bomber, which employs two, mounted in reversible wing nacelles which are jettisoned after take-off.

A standard liquid version of the Spike has been developed for the same purpose and for guided missile propellants. This and the variable thrust Spike are in limited production. Five variants of the Spike thus far have been developed by de Havilland: D. Spike 1, 3 and 5 variable thrust versions and D. Spike 2 and 4 constant thrust units. Ministry of Supply contract for the constant thrust Spike was received in 1955 and the first such unit ran in 1955.

British Army Develops Anti-Tank Missile

London—British army disclosed a new anti-tank guided missile with an accuracy which it says can be successful not in yards or even feet but in inches. "Missile, not yet in service, is guided visually onto the target with a remote operator receiving a combination of a viewing signal and a periscope. It was developed in Australia.

Improvements Slated For German Airports

Bonn—USAF has selected 514 rail tons for the biggest U.S. military delivery expedition in Germany since the end of the war.

"Twelfth Air Force still the funds will be used to extend the 10th SAC Reconstruction Wing's present run way at Spangdahlem to 10,000 ft.

Programs for spending U.S. dollars for construction in Germany were established by agreement in late 1946 between the German Finance Ministry and the U.S. State for and at that time construction has been paid for with Deutsche Marks angustering from occupation costs. German Support Defense funds and Marshall Aid counterpart funds.

"Work on the runway extension has

started and is slated to be completed in 90 days.

Only seven other runways in Europe are currently in the 10,000 ft category. Other nations part of the Iron Curtain and most of the Atlantic which are being made those in North Africa at Ben Gourn (14,800 ft), Noumerat (12,200 ft), and Wicheba, Tripoli (11,000 ft). A facility at Larnaca field in the Aegean is 10,400 ft long.

A 17th Air Force spokesman said the program known for the longer Spangdahlem runway is to handle more medium aircraft including the B-46, multi-jet reconnaissance bombers, used by 10th, 1st AG Reconnaissance Wing. Should the runway expansion plan proposed by President Eisenhower come into effect, the B-46 expansion would likely, such as Spangdahlem would probably be topped for part of the



XSM-64 Launching

Interim version of North American Nucleon, the XSM-64 designated by company G36, is shown by after it being launched. The missile was successfully fired at Patrick AFB, Fla. Interim version still was twice heavier than full of X-10 and vehicle. Budget has the 115,000 lb. Budget developed by North American Rockwell Division (AW Aug. 18, p. 28). Final version is designated SM-64A (AW Aug. 26, p. 37).

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San Jose Airport, Denver, Colo.

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Navy Mixes Two Generations

Navy's last piston engine fighter development, Grumman F9F Blackcat is shown in flight with its latest Grumman successor F11F-1 Tiger. Supermarine F107, powered by Caterpillar Wright J65 engine, is undergoing carrier evaluations.

grumman contracts procured under U.S. Grumman construction agreements are awarded directly to the Grumman Corporation. Wright J65 engine is being developed by a contractor mutually agreeable to both governments.

U.S. Air Force control of West German airports has become an elastic issue.

In a letter to Chancellor Konrad Adenauer, the chief executive officer of the State of Hesse has demanded that USAF turn over its part of Frankfurt Rhein Main Airport. West Germany's letter to the German.

Adenauer President George August Zinn has refused the text of the letter he wants to address along the federal chancellor to back a date for airport share. He says he has not received a reply to date.

Adenauer is leader of the majority Christian Democratic party. Zinn is a member of the Social Democrats, the country's chief opposition party.

National elections are scheduled for September 15.

The Frankfurt Airport has one way under U.S. military control for the use of NATO, the other under federal government control for the use of civilian planes.

In his letter, Zinn advised Adenauer that his state government has in tentative USAF plans to expand its runway to handle jets. He added that according to his information, the Bonn government had agreed to it.

A spokesman at the Federal Ministry of Transport denied that such an expansion had been agreed to, claiming the request had not even been made. A USAF spokesman said that if such an expansion is being planned it is at a higher level than the European command one. However, he added that the Air Force does not plan to release Rhein Main and that no Germany request to the effect has been made.

Zinn's letter is seen as an election maneuver in the regionally contested campaign. It is also part of a running battle between Frankfurt and Bonn for top place among West Germany's civil airports.

maneuver in the regionally contested campaign. It is also part of a running battle between Frankfurt and Bonn for top place among West Germany's civil airports.

With the Wijk Airfield, halfway between Bonn and Cologne, now officially returned from British control, the Frankfurt location are worried that an all-out airport will have an edge over a mixed military-civilian one.

Federal Transport Minister Hans-Christoph Seebohn probably had these facts in mind this week when he said he believed the civilian side of Frankfurt Airport will be the first in West Germany to handle two-engine jet passenger planes. He said he did not think Air Force planes would interfere with jet passenger planes because the Air Force has its own runway.

The runway-saturated runway has been extended from 7,600 ft. to 9,500 ft. but the additional length will not be opened until September 1. Transport Ministry officials say that another 1,360 ft. can be added within three to four months in order to accommodate jet transports.

United Aircraft Plans \$2,500 Engineer Prize

East Hartford, Conn.—To encourage technical advancement in all divisions of the United Aircraft Corp., a reward of \$2,500 prize will be awarded annually to the company for the outstanding engineering accomplishment in a company engine.

Members of engineering staffs of United's three divisions, Pratt & Whitney, Hamilton and Hamilton Standard, are eligible. No age limit will govern the selection and even engineering at home, large or small, will be considered.

Award will be named after the late George J. Moad, one of the company's engineering heads of Pratt & Whitney, when it was first awarded in 1957. The design Pratt & Whitney's first radial air-cooled engine has which evolved the Whispac series.

880 Requires Special Camera for Templates

These template camera has been acquired by General Dynamics Corp., San Diego Division of General Dynamics Corp., for work on the 880 jet transport.

Built by Robertson Photo-Mechanics, Inc., Chicago, camera is 30 in. long, 11 in. high and 7 in. wide, weighs more than 10,000 lb. and will be able to use 16-mm. motion picture cameras ranging up to 12 ft. and within 1/2000 in. increments. Used with 40 in. film or plate, it is focused manually or electrically with mechanical/electronic controlling feature.

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3	3.0 W	3.0 W	3.0 W	3.0 W
4	4.0 W	4.0 W	4.0 W	4.0 W
5	5.0 W	5.0 W	5.0 W	5.0 W
6	6.0 W	6.0 W	6.0 W	6.0 W
7	7.0 W	7.0 W	7.0 W	7.0 W
8	8.0 W	8.0 W	8.0 W	8.0 W
9	9.0 W	9.0 W	9.0 W	9.0 W
10	10.0 W	10.0 W	10.0 W	10.0 W

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A new transistORIZED servo amplifier suitable for driving size 1, 2, 3, 4, 5 and 6 servo motors is now available. This amplifier provides a 40 volt, 400 cps output. Designed to meet the requirements of MIL-STD-883C in use for operation over the ambient temperature range of -54°C to +125°C. The amplifier is rugged and is designed to be used with any Kearfott servo motor. Dimensions: 1 1/2" x 1 1/2" x 1 1/2" high, weight 4.5 oz.

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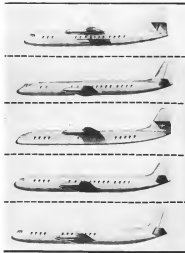


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Vickers Tooling to Produce Vanguards



Weybridge, England—One of the largest tooling programs ever undertaken for a European-built aircraft is well under way at Vickers-Armstrong (Aircraft) Ltd. for the turboprop Vanguard aircraft.

Vickers estimates the total market requirement for the Vanguard at about 210 aircraft and is tooling up for four-month production. Initial production will be at a three-month rate in 1960.

British European Airways and Trans Canada Airlines have ordered 20 each of the big turboprops, which are powered by four Rolls-Royce Tyne engines. First BEA aircraft is scheduled for delivery in the spring of 1960 and TCA will get its first Vanguard in the fall of that year. Next customer on line is being offered 1961 delivery.

No Prototype

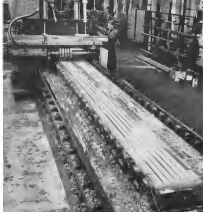
There will be no prototype. The first aircraft is being built on production jigs and should be taking shape. Fuselage assembly is to be completed in December, with wing cutting scheduled immediately thereafter. First flight is set for September of next year.

Production planning for the 55-625 passenger Vanguard presented an entirely different set of problems to Vickers than did the smaller Viscount, on which sales are now approaching the 400 mark. But the firm was able to draw on big-aircraft experience gained in building the Valiant bomber.

The 410-mph Vanguard, in fact, is being planned into the same building at Weybridge which turned out the Valiant, an which production is now under way. More than 250 designers were at work on the Vanguard tooling program at one point and the results of their labor can be seen in the large jigs now going up on the concrete floor at Valiant jigging centers there.

SIXTY project studies were made for the Vanguard with three for its fuselage. High wing design, with disadvantage of gear storage position, was killed by Trans Canada Airlines' experience based on wing-doubling disadvantage. TCA also clipped that walk-high wing airplane pilot would not be able to see whether snow had been swept clear from wings, an important consideration in Canada.

COCKPIT mockup of Vanguard is for both European Airways airplanes (right) but for third crew member is visible in foreground.



STRONGERS for Vanguard's wing panel are milled on an Corrad A-99 gear milling machine. Table of machine is 45 ft. long and 3 ft. wide. Carbide tipped milling cutters are of aluminum mounted both ways.

With a fuselage length of 322.8 ft. and a wingspan of 118 ft., the double-hulled Vanguard will be one of the largest airplanes in the air. This is reflected in the 18 ft. high cut-away fuselage jigs at Weybridge.

Fuselage assembly of the Vanguard takes place in three major steps:

- Construction of five subassemblies—cockpit section, forward fuselage section, wing center section, aft fuselage section, and tail cone.
- Cockpit joined to the forward fuselage section and the tail cone to the aft fuselage section.
- Union of these three major subassemblies to form the completed fuselage, an event that doesn't occur until almost two-thirds of the way down the assembly line. This stage is added later. This method enables both the fuselage and wing to be carried to an advanced stage before joining.

The method of construction is entirely different from that of the Viscount, where the fuselage is assembled in one go.

Major assemblies of the fuselage were detailed again in a manner enabling contractors to be as much as possible

PRODUCTION

from the thin line forward. The cockpit section and center section are exceptions to this but have a remote control is used at the jig contractor to assure even mating with the other sections.

A 380 ton Hydraulic stretch press is used to stretch Vanguard fuselage panels and smaller Hydraulic for the frame sections. Fuselage is built up from pre-assembled panel-and-stranger sections. Skin is then riveted to strangers.

Support of the assemblies are the forward and aft fuselage sections. Each of these is built in two halves, with top and bottom portions being added at the second stage of assembly to form the completed fuselage sections.

Half Sections

Each of the "half bodies," as Vickers calls them, is built from 16 of the pre-assembled panels. Frames in most cases stand on top of the strangers and are clamped to the skin with six bolts in the frames. Clamps, rather than the frames, are cut out at the strangers. There is about a 10-in. gap between frames and 4-5 in. between strangers.

Wings, which are the 16 in. x 26 in. elliptical shape in a Viscount, are set at a base 70 in. apart. There are one-inch pitch vertical sections between the windows and the first complete stranger running past the windows both top and bottom but a filigree



TOP HALF of Vanguard fuselage assembly is put together on jig. Cockpit assembly is complete in most of Vanguard fuselage construction that is designed to be as much as possible from this last stand.



The emphasis is shifting

It used to be that you would design an airborne jet payload—and provide minimum required instrumentation.

The emphasis is shifting.

In this new age of electronic missile guidance and identification, the chicken is now the egg and the cart pulls the horse. Instrumentation

comes first—after which a mobile container is designed that will carry it with greatest efficiency.

This shift finds the sturdy shoulders of Stewart-Warner Electronics bared for the greater load. Stewart-Warner has pioneered in electronics for thirty years. Today, S-W Electronics is pioneering in the stereoscopic electronics of tomorrow.



which picks up these vehicles.

Four stations there is a "topset" integral section around each window with a subplate which picks up on the frame, integrals the windows. Although there are separate closets at all other fuselage and structure junctions there is a continuous cloth in the window region.

These are doubling around the door area end, at some points, tripling, with the basic idea and two doubles.

The floor structure provides the tie between the upper and lower sections of the double fuselage.

Tail cone is built as a single unit while the midleg is built as two halves, split at the floor level. The nosewheel bay is an superstructural bay in the wing section.

This differs from the Vanguard in which the whole underside of the nose section is superstructural. Upgo, curved areas in the Vanguard to add nose to the nosewheel bay are the nose radome and the tail cone.

Greater Section

Fuselage center section where the wing joins the fuselage is built around a wing torsion box where three shear webs are hung onto the frame main frames. Although the wing torsion box itself is pre-assembled, this section of the fuselage is built as a complete assembly with no pre-formed skin.

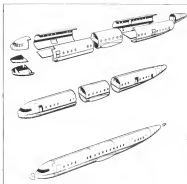
Three main frames which carry the shear webs are brought to the point where the load drops off and then re-tie to the fabricated assembly of other frames. There is more extensive clamping here than in the line and aft fuselage sections.

Torsion box stiff panels of course, below the flooring and the stubs from the shear webs extend outside the fuselage slightly to pick up the wing section.

A cushion provides access into the torsion box, through the forward sub and from there to the integral tanks in the wings. Substans and clamping pins under the torsion box.

There is an electrical bay forward of the box and a hydraulic bay aft. Access to these is through cutouts in the bottom of the fuselage. The hydraulic bay is a self-contained compartment which is pressurized at a slightly lower pressure than the 6.5 psi working pressure of the cabin. In pressurizing the hydraulic bay, a bleed valve is used to bleed the bleed air into the bay which prevents cabin contamination.

The three shear webs which form the two bay torsion box carry throughout the wing. Integral construction is used for both top and bottom sections of the wing torsion box, with leading and trailing edges and tips being added after the box is joined to the fuselage. This differs from the Vanguard procedure



FUSELAGE ASSEMBLY whole and half sections in pieces (above). One of partly completed half bodies on jig is shown below.



in which the wing is assembled as a unit.

Each wing contains, on its bottom surface, two constant and two tapered wing panels, and two constant and two tapered outer panels. The top surface is the same except for providing four cutouts for access to the wing tank.

Access to the outer wing tank is through removable panels in the leading and trailing edges.

The two integral integral tanks of the Vanguard carry 2,228 U.S. gallons each and the two outer tanks 940 U.S. gallons each.

Altogether, there are 56 panels of



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varying shapes used in the construction of a Vanguard wing from tip to tip. These are called from stretch-bent panels which vary from 15 to 25 ft in length, from 27 to 30 ft in width, and from 11 to 3 ft in thickness. Upper panels are BT-D 5020 and lower panels are 24574.

The panels are first surfaced on a Caneve machine designed for the job. The shapers then are rolled out on an Orend A-60 tape rolling machine which has a table 45 ft in length and 7 ft wide. Carbide tipped rolling cutters use one of the adjustable stretch-bent tape.

Edge profiling is done on a Caneve profiling machine which has a table 42 ft by 6 ft.

After milling, the skins are cured by hot forming and heat pressing. The forming is done on a Vickers-designed machine built by Altkind Ltd. The heat pressing is done on a Vickers machine which uses 8,000 lb diameter steel shot. Rate of heat dissipation that produces the desired degree of curvature.

In construction of the wing, the sheet will be built up separately, and then the wing boxes will be assembled in the main wing box.

Since the wings are reinforced, they will be painted. It is therefore planned to paint the entire aircraft and an experimental panel job now is being applied to a Viscotec in anticipation of the Vanguard requirement.

In use of the integral construction employed in the wing, it is interesting to note that the Vanguard design calls for a high-wing aircraft. It was designed especially to specifications laid down in 1957 by British European Airways and BA devised a high wing as a result of its favorable experience with Embettors.

High Wing Studies

"An immense amount of work was done on high-wing design studies," Vickers spokesman said. "Not only were the airplanes shown on paper, but preliminary weight and stress calculations were made, and performance and economy calculated for the various configurations. Very interesting high-wing aircraft were evolved."

Town Canada, which owned the patent at this time, put forth some strong arguments against the high wing, however.

TCA insisted that a high wing would not be acceptable in the U.S. and Canadian market, that it presented serious emergency problems, increased landing risk, and made it impossible for the pilot to see from the cockpit whether the wings were free of snow—an important point to Town Canada.

So the low-wing design was adopted. Consideration also was given to making

the Vanguard a push jet but the top wing design was that point. Tight demands produced the double bubble fuselage, with its two large bubble holds below the passenger cabin.

From a cross-sectional view of the design, the choice was made in April, 1955, of the aircraft which is being built today at Westbridge, B.A. placed an order for 20 in 1956 and the first Vanguard in January of this year by a TCA order for 10 with an option on four more.

TCA and it placed its order only after an "extensive analysis" of all types of American and British aircraft on order for the 1950s.

According to Ralph Kosen the stage 1 Type will be available in 1959 to provide a Vanguard cruising speed of 410 mph. Stage 2 Type (1960) is to reach 475 mph, while stage 3 Type (1962) will have a corresponding cruising speed of 440 mph.

Various Configurations

Vickers is offering the Vanguard in a 70-passenger first class configuration, 85-passenger mixed version, 95-passenger tourist layout, and 125-passenger coach configuration.

Actual weight of the wings up to 2,600 miles. Maximum gross lift-off weight is 141,000 lb. Payload is 24,000 lb. Vickers notes that approximately two-thirds of the Vanguard is painted can be carried in the underfloor hold, providing freighter operation without modification of the passenger cabin.

The two bubble gives a total volume of 1,410 cu ft. The forward one has 25 ft in length and the rear one, 22 ft 3 in. Both have an interior height of 4 ft 3 in. Loading doors are 5 ft 8 in by 3 ft 10 in. The doors are vertically opening "cheesehead" with the two bubble construction.

Loading is at track-level height.

Studies have been made of an all-freight version of the Vanguard which would have a 7,110 cu ft capacity for 60,000 lb of cargo carried in three compartments. The main cabin and the two lower holds in the aircraft, the new passenger door would be replaced by a large freight door measuring 5 ft 10 in high by 9 ft wide with two side latches. The Vanguard freighter would achieve operating costs of 4 to 5.5 cents per ton-mile.

There are four main doors in the passenger cabin of the Vanguard—two entrance doors located low and aft on the left side, each fitted with folding steps, and two emergency exit doors on the right hand side which double as emergency exits to the galleys. In addition, there is a third emergency exit door on the left side at the rear of the fuselage.

Two cabin window emergency exits are placed on each side over the wing and windows next to the main jet

engine exhaust doors and also serve as emergency exits.

Accommodation is provided in the Vanguard 98 cockpit for a flight crew of three. There is no flight engineer's station but the third crew seat, in the rear of and between the pilots, provides access to engine, propeller, landing gear, flap and instrument controls situated on the central pedestal.

Conventional flying controls are manually operated by push-pull control rods. For parking control surfaces can be locked mechanically from a lever on the central pedestal. A venturi line connected to the Venturi does not permit sufficient power for take-off with the loads on although it allows power for loosing.

Flaps are Fowler type fitted in four sections per side and connected by hinges which come on rollers as steel guide rails. They are hydroelastic.

The Vanguard's flexible landing gear has two wheels on both nose and main gear. Since the gear retracts forward, there is a free fall emergency lowering system. Main gear retracts into the main engine nacelle.

The Vanguard drive facelined at Hamilton 18 ft 4 in diameter core.

Stage 1 Type will have a maximum thrust speed, 400 mph, propeller.

First Vanguard produced will be used for extensive flight testing but the new pure plane elements to sell it. After flight of the initial aircraft in September 1958, the second aircraft will come off the assembly line in November/December. These will be followed by four more at about three month intervals. The third Vanguard is now being built up and the fourth aircraft is now being built up and the fifth aircraft is now being built up.

PRODUCTION BRIEFING

American Aerograph Corp., El Segundo, Calif., added a Filtronic Di-Lux. The new division plans to produce Filtronic modified photo-luminescent for jet engine socket exhaust shields, aircraft wing skin fasteners, and missile fairing fairing. The new division plans to produce Filtronic modified photo-luminescent for jet engine socket exhaust shields, aircraft wing skin fasteners, and missile fairing fairing.

American Mfg. Corp., Middleboro, Ohio, said a 5,000-800 General gas turbine engine has been installed as part of the new equipment needed for its turbine reconditioning. Among personnel, an experimental program is being run by the KC-135 test aircraft with a 100-hp engine and improved 8150 ft per hour. American Corp. The gas will take 60 ft long pipes and can eventually be converted from complete control to manual control by type.



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MATS Tests 4-D Navigation in Pacific

By Russell Hawkes

Hickam AFB, Hawaii—Four Dimensional Optimum Flight Planning Navigation is getting final reaction from Military Air Transport Service, only carrier which has used it operationally. The highly refined pressure pattern navigation technique was extended range at sea test requirements in 1975 or more in some tests.

Air crews and meteorologists on the Pacific Division of MATS are generally in favor of the optimum technique. Reduction in fuel consumption has been approached 10% in the Pacific but is still thought to add up over a period of months to a significant saving. Other benefits have been an apparent improvement in accuracy and consistency of forecasts, and better team work between operations and weather people.

But a question sometimes asked is whether the benefits are great enough to match the expenditure of extra resources in preparing 4-D charts and optimum flight plans.

ARDC Contract

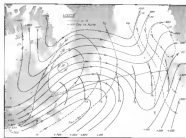
The technique was developed by Clark Research Laboratories of Chicago under a contract awarded by Air Research and Development Command. A modification for Strategic Air Command is now being developed.

The four-dimensional analysis, in its more advanced versions, takes into account atmospheric pressure variations on a scale as small as latitude, longitude, altitude and time. Winds can be derived for any point on the analysis. In release of the basic relationship between wind flow pattern and pressure pattern. The pressure pattern at a time several hours in the future can be figured by linear interpolation between a forecast and the current analysis.

Optimum flight planning uses the four-dimensional analysis, a special hand computer and a simple technique to draw from pressure data the assumed route track. The old design computer, improved long range communications and team in weathered weather prediction will increase effectiveness.

The 4-D optimum technique is expected to reach its full value with the advent of turbine-powered aircraft because of the critical importance of fuel economy in these operations. Several commercial carriers with long over-ocean routes and jet transporters, in order to save expenditures to the MATS Optimum Flight Planning School here to study the technique for possible adoption.

The accuracy of any pressure pattern



OPTIMUM flight planning used on an Atlantic flight. Chart shows selected heading between two points on a flight from Goose Bay to Fanning.

navigation method decreases in low latitudes and within 70 deg of the equator is so slight it is made the method of choice. At Fairchild Research Center is currently working a way of fitting the lower latitudes into the 4-D optimum flight planning technique.

MATS Pacific Division routes track into what is probably the most considerable area yet to be flown operationally using the optimum technique. Knowledge of these routes at Hickam, located about 20 deg north latitude. The great expense of the area, quality of reporting points in the weather observation net and the volume of pressure gradients during the summer months all contribute to the difficulty of operating on optimum. In winter, when pressure gradients and hence winds are stronger, the profit is much greater. The division would like to do service from Tokyo to Hickam, dipping the coast line step at Midway. This would produce a considerable saving in time and expense. According to the Jet Weather Wing based in Japan, that is impossible in summer and possible in winter only with the use of optimum flight planning.

Experiment has shown that the optimum track often lies quite close to the great circle track or the dumb line track on Pacific routes. To use such hours, the division has adopted a modified method using an selected tracks between Hickam and the MATS

West Coast terminal at Travis AFB, and 11 selected tracks between Hickam and Tokyo. On the basis of such an analysis, an optimum track is plotted for each route and all flights are dispatched along the closest selected track until the next periodic computer analysis is released.

An hour and 20 minutes is required to make an optimum flight plan while only 20 to 25 minutes is required to make a selected track flight plan. The selected track plans are pre-printed and the problem is largely reduced to one of card indexing. Since the track selection is based on an optimum plan, some of the advantages of optimum remain. ATCRA is working on modifications of plotting some of making past optimum more economical in time.

Weather Data

Meteorologists find that the percentage increase in fuel economy could be substantially raised if the number of weather reconnaissance flights over the route were doubled. This would increase the density of reporting points contributing to analysis and thereby improve the accuracy of forecasts. The purpose of the technique is to get the best possible use out of available weather data and weather forecasts. But forecast accuracy is now less than the potential precision of the optimum flight planning method on which the 10% figure is based. This being true, forecast accuracy is an important factor.

ing factor on the advantages to be realized from the technique. If it is improved it might justify a return to great operations even without anticipated improvements.

Rigid air traffic clearance and the difficulty of radio communication over the long distances involved tend to prevent crews from getting the most out of optimum because flexibility is one of its chief characteristics. Designed for use in areas where weather reporting will probably never be as complete as it is in the United States, it makes available to the navigators methods of flight re-analysis on which to base flight plan amendments.

Habituals to make full use of the refinements given by re-analysis rely upon the accuracy of some of its advantages. Present clearance limit a flight to a 50 mile radio corridor and clearance an opportunity to "ride the weather." One MATS pilot has suggested that operators would show a bigger advantage if it were not for the fact that aircraft often carried by MATS aircraft as a safety margin. He reports that these elements contribute to the work necessary to get the most from optimum. Disturbance can always be reached easily and the cumulative value of a few hundred pounds of fuel and a few minutes of flight time saved each

flight are not always recognized by the crews.

Meteorologists and navigators agree on the more objective and more useful continuous representation in the 4-D analysis. The former method of presenting winds at certain points in space and time required the navigator or a meteorologist to split the difference subjectively to make data applicable to a specific route and altitude. Since 4-D analysis is somewhat more objective than former methods, it produces a better forecast in the hands of experienced meteorologists. Subjective methods are required only by experience.

Contour Map

The 4-D analysis is a contour map showing the variations in true height of a certain value of barometric pressure in pressure altitude. In the standard atmosphere, values of barometric pressure are assigned a normal height. Therefore a pressure can be identified in terms of its normal height. This is pressure altitude.

The basic term in the analysis is D value, the difference in feet between the pressure altitude at which the analysis is being made and the true value of true altitude at a point on the map.

Essentially, it is the altimeter correction needed to derive true altitude from pressure altitude.

The advantage of using D value rather than weather, the conventional meteorological unit of pressure, or the true altitude of a given pressure level, is that the numbers are kept small for ease of computation and it is a relative term easily modified by other altitude parameters.

If the true altitude of a point is higher than its pressure altitude, then a plus D value is recorded. For instance, if pressure altitude at a point is 16,600 ft and true altitude is 16,400



Redstone Airlifted

Aero's Redstone missile, produced by the Chrysler Corp. near Detroit, is loaded aboard a USAF Douglas C-124 Globemaster for transport to test site at Patrick AFB, Fla. USAF Major and Chrysler representatives speculate against placing of public missile should transport and the taking down for the trip.



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it, D value is $+600$. If true altitude is lower than pressure altitude at a point then a minus D value is recorded. When conditions are standard and connected pressure altitude is the same as true altitude, D is zero.

On the 4-D analysis chart, lines of equal D value envelopes the contour lines are drawn and each line is separated from the next by an altitude difference in D value such as 200 ft. The horizontal distance in miles between the contour lines divided by the vertical difference in D value between these represents the rate at which pressure rises or falls along a horizontal mile at the moment the analysis is made. The steepness of this gradient indicates the steepness of the pressure surface.

In the absence of a dense network of stations reporting actual winds, a theoretical approximation is used to correct pressure distribution to winds. This approximation is based on the geostrophic assumption that winds will flow parallel to the pressure level contour lines and with light pressure to the right and heavy to the left at a speed (roughly) proportional to the spacing between the lines.

The steering force behind the wind is the pressure gradient force or tends to flow down the gradient in steeper light and 80 lbs. In geostrophic flow, the direction of the wind is not across the contour lines as might be expected, but parallel to them because Coriolis force deflects moving air toward to the right in the northern hemisphere and to the left in the south or hemisphere, opposing the pressure gradient force. When the velocity of the air mass is great enough to generate Coriolis force equal to pressure gradient force, the resultant direction of flow will be parallel to the contour lines.

Known Error

There is a known measure of error in the geostrophic approximation because of the effects of surface friction and centrifugal force in curved flow, but the error is of the same order of magnitude as the probable error in the plotting of the pressure distribution on which the wind calculation is based so it is generally ignored. Inaccuracy of the geostrophic wind in a representative of the actual wind is usually limited to an error in velocity. Direction of flow conforms quite closely to theory.

If pressure systems never shifted or changed and if the flight were made at constant pressure altitude of the surface, the geostrophic approximation and the D analysis would make possible good pressure pattern flight plans. Since they move and change conditions and since flight must often be made at altitudes other than that of the analysis, the 4-D analysis concept

uses exact gradient type pressure surfaces for change in D with time and altitude.

Velocity of D with time is designated by the Greek letter Tau. The Tau value is stated as change of D in feet per hour. A rise is recorded as a plus value and a fall is recorded as a minus value. The meteorologist derives it by interpolating between the current analysis and a forecast. If it is a 24 hour forecast, he will measure the variation of D for a number of points in that period and will divide the variation at each point by 24 to arrive at the Tau value for the point. Lines of equal Tau values are then plotted on the 4-D analysis so that the flight plan can be calculated between adjacent lines to get Tau for any point on the map.

The flight planner multiplies the Tau value at a point by the age of the study in hours and adds this to the D value on the ambient to get D value at the time of flight. As the flight pro-

gresses and the analysis ages, the wind-ages of Tau used increase at one per hour. Each hour's flight is based on a forecast for the appropriate hour.

S Values

The analysis is translated to other altitudes by means of the S value which is the D change in feet per thousand feet of pressure altitude. S stands for Specific Temperature Anomaly and means the variation of temperature at a pressure altitude from the comparison at that altitude in the standard atmosphere. The thickness of a layer of air with a given mean pressure thickness is dependent on its mean temperature, therefore the D value at a pressure altitude surface in the layer can be calculated from the temperature anomaly and the known D value at the ambient altitude.

The tool for figuring S value is a graph known as a Potogon which gets its name from the words of Potogon



Moon Radar to Track Satellite

Delta Moon Radar Antenna presently is being used to calibrate Mustang equipment in preparation for tracking of the earth satellite to be launched in conjunction with the International Geophysical Year. Data, a development of the Army Signal Engineering Laboratories at Fort Monmouth also is being used in studies of moon radio reflections

Altitude vs. Specific Temperature Anomaly. The S value is indicated in the point at which the appropriate temperature line intersects the appropriate altitude line. If the temperature is above standard for that pressure altitude, the sign of the S value is plus; if it is below standard the sign is minus. The S value is multiplied by the number of thousands of feet between each altitude and flight altitude and added to the D value at the analysis level. If flight altitude is higher and subtracted if flight altitude is lower.

In MATS Profile Deviators, the size of S has been abandoned as it is the only part of the analysis which must be retained in case Deviator meteorologists find that an S value interval basis will in fact not work properly; especially where most of the deviator's flight is within 2,000 ft. of the regular 700 weather (M30) ft. pressure altitude analysis. The D change in the Deviator is not substantially significant. The S value is now used occasionally, and for night research. In the use of a based upon observations made only partially after this plan is in the air.

An experiment track is laid out on a 4-D analysis chart by connecting hourly time points between departure and destination and then plotting hourly headings. The first time interval is constructed by plotting the points which would be reached after an hour of flight on a series of possible headings and drawing a line between these. This

is the true front. The shortest distance is under the curve at the point of departure and, as the point on the true front is equal to ground speed times the time of flight is an hour. Successive true fronts at the end to the destination are laid out by finding the points reached after an hour's flight on heading perpendicular to the last front and joining them to the new front.

The hourly true fronts could be constructed by ignoring a great many point values by means of the geomorphic method and then recognizing a series of wind triangles to get ground speeds with which to plot the points for the construction of each true front. Obviously, the true square for this would be prohibitive.

Plastic Computer

Cook Research has created a mathematical plastic computer which can be used to do the without calculating with or drawing or other devices. Based upon the perpendicular relationship between pressure gradient and wind direction, it derives lateral or headwind component from the pressure gradient along a reference line perpendicular to the heading and crosswind component from the gradient along a reference line to the heading. The latter are drawn on the computer in the form of a cross and are the same relative length because the change in D value from one end of a reference line to the other is the basis for calculation of one of the wind components.

points. If D value falls from the right end to the left end of the lateral line there will be a tailwind and its strength will depend on the amount of the drop. If D falls from left to right there will be a headwind.

If D value falls from rear to front along the heading line, the crosswind component will be down left to right. The reverse will be true if D falls from front to rear.

Since the duration of flight can be found before the track is drawn, steps for computing the three fronts, the first squariness can be established 15 or 20 minutes before the flight plan is complete. The track, the first down back and down distribution in the departure.

The heading from the last front to the destination should be perpendicular to the front to give the minimum track. The computer is then used to figure the drift in miles due to crosswind at each heading in the duration of an hour required to reach destination. A point is marked on the chart equal to the distance a distance equal to drift. The heading line is drawn by joining this point and the last front. Where the two intersect is the point of departure from the last front to destination. A line between the point and the destination is the new wind line. The heading from the last front to destination is drawn through the point of departure from the last front to destination. The heading from the last front to destination is drawn through the point of departure from the last front to destination. The heading from the last front to destination is drawn through the point of departure from the last front to destination.

The point of departure from the last front is now the destination. The heading from the last front to destination is drawn through the point of departure from the last front to destination. The heading from the last front to destination is drawn through the point of departure from the last front to destination. The heading from the last front to destination is drawn through the point of departure from the last front to destination.

WHAT'S NEW

Reports Available

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Heater Tests Nose Cones

Nose cone of Army's Redstone missile is tested in this barrel-shaped heater made up of layers of more than 1,000 glass coated tubes capable of sustaining heat of more than 5,000 degrees. Heater is used to test Redstone nose cone in a wind tunnel where Redstone is accelerated.

EQUIPMENT



ARTIST'S (group) of West Field installation shows how easy it is to turn a plane (left) and return for additional aircraft. Speed of movement can be controlled from the small shack in the background.

Carrier Deck Gear Development Pushed

By George L. Christensen

Laird, N. J.—Future of transcribed random lengths on packing development of branching and rowing versus steady state of development of the growing stable of high performance aircraft being designed, built and qualified for fleet operation.

This program, which already has resulted in development of an internal combustion aircraft not dependent on a nuclear carrier's reactor, is spending the Navy into creating \$155 million in a new tracking and recovery system test facility here. To date, about \$23 million is already under contract.

Called Naval Air Test Facility (NATF installation), the center is being built around one of a 4,500-acre scrub pine site at the Lakeland Naval Air Station, known historically as the Navy's light-tower or headwaters.

Reason for building such complexes and facilities for NATE is to attract



HIT CAR, powered by four 101-hp (400-hp) engines (total load at 10,000 lb), is speed of 175 mph for taking strength of reserves. Car (new) shows well load (into gear).

that, as new, increasingly hot and heavy planes move out into the fleet, current catapults and arresting gear will be capable of handling them. If catapults or arresting gear are inadequate or become obsolete, then \$200-million ships in the Forrestal, Saratoga, Ranger and the proposed atom-powered CVAN (Carrier Attack, Nuclear) become more fitting targets because of their inability to make these jet phase striking force operational.

NATF's Dual Mission

Capt. R. M. Tinnell, Buair Project Officer at the facility, told *Australian Women* that the mission of NADP is to evaluate aircraft launching and recovery equipment and related components. It will take all such gear and test and evaluate it to determine whether it is suitable for a given class of carrier below the equipment is committed to a ship. A catapult is such an integral part of a carrier that it becomes a single

operation to remove it should it be unworkable.

Second part of our mission is to support the development of launching and recovery systems by providing facilities and services to contractors and government agencies engaged in development programs in this field," he said. "Contractors will find here a facility where they can conduct, with their own people if they desire, large scale and diversified tests on their recovery."

Some of the more important problems the faculty will tackle:

• **Launching.** Possibility of higher launching and recovery speeds to pre-empt designs a first land to develop very high performance aircraft will be recognized. Faster take off and landing speeds will impose greater G forces on pilot, aircraft and equipment and the Navy wants to find what the practical limits of these forces are. Current estimates require a peak of about 10Gs on the pilot during the two second launch arresting loads are about 1.14Gs.

If it is found that higher launching Gs will momentarily black out pilots, a requirement may be created for a device which will automatically take the plane off from the carrier and control it far enough around of aerial flight to allow the pilot to recover sufficiently to handle the controls.

Another problem is that the reactor of the Navy's proposed nuclear-powered carrier will not develop the approximate 500 psi of steam pressure required for catapult operation. Therefore, a program is under way to develop catapult-powered engines, independent of the

tractor. Newton Motors, Inc., has designed an air/gas generator, prototype of which is being tested at the Naval Air Jordan Test Station, Lake Oswego, N.J. (AW Aug. 12, p. 21) and is called Internal Combustion Catalyst Powerplant (AW May 6, p. 30). Second KCF, now under construction, incorporates several improvements resulting from tests at the rocket station. It will undergo a two year development and evaluation test program at NATF.

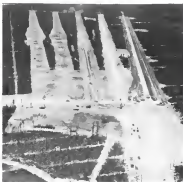
- **Recovery.** If higher leaching spots become practical, then recovery systems capable of handling higher leaching spots must be developed simultaneously.

Vibration Problems

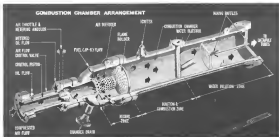
An associated problem relates to vibratory loads, induced in cables by stretching hooks at heavy and high speed pulls, which spread through the wire into both the straining engine and the refuse, now damage either or both. These vibratory stresses may also snap the cable itself, causing a hazard. The overall vibration problem is spawning a priority NRC research program into vibration dampers to alleviate the difficulties.

Of the facilities which the Navy will provide when the facility was full swing, possibly by 1960 some are already completed and a majority are under construction. The rest are in the planning stage now.

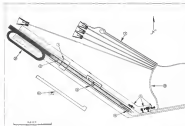
Recovery Surface Test Site consists of five wet and five dry, bare tracks. On these tracks, set



FIVE TRACKS are planned at Recovery Section Test Site and one (right) already is in operation. It is 9,880 ft. long. CR (the four other tanks under construction, there will be 7,368 ft. long and the last will be 12,608 ft. long and capable of test speeds up to 274 kt). It is test track on left. Jet sea will be used on track to push deadlocks in accelerated current into swirling core section.



REACTION MOTOR'S Internal Combustion Outboard Powerplant is shown in this drawing for the first time. Compressed air enters at 10L, is mixed with JP-8 fuel in spray chamber and ignited. Water, pumped into the machine through aperture, is heated into steam by heat of burning JP-8, expands rapidly and is directed in outboard water through opening at right. Device can respond to power GUN stroke by placing in Nozzle CYAN (cyanide/poisoned cancer) because steam pressure generated by motor is well below the 800 psi needed to split outboard SAW Arm. (U.S. Pat. 3,730,000)



LAYOUT of Naval Air Test Facility (Ship Interceptors) at Lakehurst NAS. Facility includes: (1) Recovery System Test Site with five jet air tracks; (2) 5,000 ft runway with 4,000 ft extension at upper left; (3) Runway Arrested Landing Site; (4) C13 and C14 catapult installations; (5) Short Field Installation with seven tracks; (6) High-G test facility; (7) Sea pollution area (portable) around gear test site; (8) Powerhouse, Special Projects and Engineering buildings; (9) Aircraft taxiway.

can powered by old model aircraft jet engines will guide deadfalls of aircraft weight at high speeds. At a preselected moment, the engines are shut down and the car quickly will be braked to a stop. The deadfall harness acts as a sliding cable at a velocity equivalent to a plane's landing speed to test the recovery system. Dual counter-mounted steel rail guide car and deadfall down concrete runways.

First track, 5,500 ft long, is in operation. Car used is powered by Fiat J34 turbojets and carries a deadfall made of strand steel beams mounted on four perimeter steel wheels. Weight is 25,000 lb. max, 70,000 lb. full weight.

Car was designed and built for the job by All American Engineering Corp. which has completed a second J34

powered car, very similar to the first. Certain working modifications made in the car can make its components more accessible, increasing its maneuverability. Company is also currently preparing for operation of the track at NATF which has a capability at 175 ft with the 50,000 lb. deadfall.

Other test tracks are under construction. There will be 7,500 ft long and will have 100 lb. capabilities with 10,000 lb. deadfalls. Last track will be 12,000 ft long and will have a 250 lb. capabilities with the same 10,000 lb. deadfall.

Recovery System Test Site will be used exclusively in test involving gas recovery. Jet cars will also be used to peak engine, unbraked aircraft onto the recovery system to evaluate their

compatibility with actual recoveries under circumstances which cannot be duplicated with deadfalls.

One site for catapult system is being built at the southeast end of an already completed 5,000 ft runway. A 4,000 ft extension to the southeast is being proposed.

Reason for building a new runway is dependent of existing landing facilities of Lakehurst was that runway length might not be adequate to handle some of the newer planes. Also, the Navy did not want to clutter up a busy, operational air field with catapults and arresting gear.

Catapults are put at the end of the runway rather than on the recovery system test site so that, if one fails, the other still can be used.

Currently under construction at the runway are runways for two catapults. One is a standard steam-operated C13 unit being built by the F. W. Rice Company. Feature of the C13 catapult facility is that the entire length of the catapult—about 750 ft—is elevated so that above runway level. A fixed ramp leading to the catapult allows planes to taxi or to be towed into place. A movable ramp at the launching end of the catapults, when in place, allows a plane to roll down to runway level again. If removed, however, it opens an air foot drop at the launching end of the catapult to simulate the dropdown from a carrier's bow. This will allow planes that have a tendency to sink somewhat after launching to duplicate this tendency on the C13 catapult facility—to a distance of six feet.

C14 Catapult

Alongside the C13 is a C14 catapult. Built over-type, slightly on the end piece of the runway 4,000 ft long.

C14 catapult is also being built by Rice, but the engine powering it will be RALIS owned lateral Cousteau system. Jet cars will also be used to peak engine, unbraked aircraft onto the recovery system to evaluate their

as large quantities without increase in a carrier's losses at sea.

The catapult will use steam as a fluid medium, instead of about 15 ft in length and has an overall diameter of approximately 24 ft. To produce power for the catapult air compressed to a maximum pressure of 1,500 psi is introduced at the small end of the powerplant. Air is directed to a moving zone through a perforated or diaphragm. JP-5 fuel is injected into the moving zone through several nozzles located around horizontally around the powerplant. JP-5 fuel is used to supply liquid water at a closed the center for the jet plates.

Catapult Operation

The fuel/air mixture passes from the moving zone to the injection and combustion zone through a flame holder and is ignited by an electric spark. The very hot flame impinges on a water surface in the center of the combustion chamber. Water is forced through perforations in the injector is instantly heated to steam by the intense heat. Steam passes through the water diaphragm zone, which contains two sets of moving bellows, then is directed to the catapult tubes.

Steam performs the dual job of greatly increasing the mass of the propellant and also cooling it below it enters the catapult tubes to drive the piston down the tubes.

A major difference between the C13's and C14's operation is that the latter generates power as it is needed instead of drawing on power (steam) stored in large accumulators. Problem facing the C-14 is to generate power rapidly to provide a constant rate of acceleration to the plane being launched to keep C losses at a minimum.

Extending 480 ft from the launching end of each catapult are tracks extending below the surface of the runway. These will be used with friction type brakes to stop deadfalls fired by the catapults during tests. A family of deadfalls will be available with weights ranging from 10,000 to 100,000 pounds.

Catapults will be used to catapult either deadfalls or planes, depending on tests being conducted.

At the 4,000 ft end point of the runway, construction is under way on a Runway Arrested Landing Site (RALS) which will be used to test and evaluate arresting gear systems, including engine and braked. Braked are emergency deceleration units are composed of nylon webbing—used in a building to halt a plane in case it fails to engage the arresting gear. They are not the same as the cable barrier for normal use on carriers.

RALS includes a large substructure, some capable of accommodating an arresting engine of the Mark 7 type and



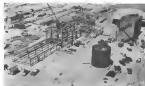
RECOVERY System Test Site. Arrow's drawing shows jet air track (circle) and deadfall harness (cross) (right). Aircraft taxiway is at top (background). Trusswork in trailer are present from stopping of broken cable by earth movement.



FACILITIES at southeast end of 5,000 ft runway include: left to right C14 catapult, jet air track, deadfall harness, and RALS control station. Runway taxiway is shown at top.



RUNWAY Arrested Landing Site drawing shows under runway installation of Mark 7, Mark 2 emergency deceleration unit and RALS control station. Runway taxiway is shown at top.



POWERHOUSE Powerhouse is shown (left). Aerial photo (right) shows C13 steam catapult (left) and C14 diesel catapult construction project. Note how C13 installation is raised 6 ft above runway.



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size. A ML-7 type sensing capsule is as broad as approximately 6 ft. wide, 2 ft. high, 50 ft. long, weighs 68,000 lb. and costs about \$110,000. A complete set is usually installed on a carrier.

Four ML-7 Model I sensing air guns, the usually carrier being used aboard operational carriers, are being installed at RALIS. Two additional air guns will be added when needed.

RALIS is worked on several occasions to quick, successful carrier launches to test various launchers. Launchers on some carriers take places about in 20 sec and afterwards can be duplicated by RALIS by moving a plane up to a down stop in the right of the runway immediately after it has been catapulted from the starting place to allow succeeding planes to land. It is the quick successive of launches that puts the carrier stress on an aircraft carrier—the port strong side of the engine. This is particularly true if several successive planes engage the same area instead of distributing engagements over the water available.

Rapid successive launches cannot be duplicated on the jet on recovery tracks because it is impossible to fire the dead loads and return them in the opposite end of the track fast enough to simulate 20 second interval launches.

Arriving gear returns must be evaluated with actual results to give realistic performance data and to meet the present plans of the aircraft carrier. Routine is that the aircraft gear acts in a spring while the aircraft is an elastic mass with a structure that has a certain amount of give, and is equipped with landing gear struts that partially collapse upon landing. Descent loads of heavy steel beams welded together and riding on bearings which are rapid success where gear descent returns to an aircraft carrier's operation.

RALIS was previously specified half-size, down the runway so that planes could be put into it from either direction, depending on wind conditions, and still have 4,000 ft. left for a go-around if necessary. When the actual 4,000 ft. are built on to the runway, there will be 8,000 ft. available southeast of the RALIS.

Big Powerhouse

A large powerhouse is being created adjacent to the southeast end of the runway to supply power to the steam and air/gas turbine catapults.

Steam for the C-14 catapult will be regulated by four high pressure boilers which will produce 50,000 lb./hr. at 1,150 psi. The combined output power will be used to operate the catapult.

With boiler will supply low pressure, utility steam.

A compressor plant within the power-

British Exchange Program

U. S. Navy spokesmen have high praise for the many "developments of Britain's Royal Navy and the exchange program which has allowed this country to develop them to the current state of the art."

Among the British concepts which have been implemented in improving the operational efficiency and safety of high performance aircraft flying from carriers are angled deck stress supports, and instant landing system.

airbase will supply compressed air to the C-14 catapult.

Two large steam turbines of 7,500 hp each will drive a three-stage air compressor to provide the quantity of air required by the C-14's National Gas-Catapult. Catapult pressure. Turbines are being supplied by Westinghouse, compressor by General and sub-contract to Reaction Motors.

On top of the powerhouse will be a well control tower which will be used primarily to control action of the catapult and RALIS sites. Aircraft flying into or out of NATF's runway will be controlled by the regular Lakeland tower, at least for the time being. A guideline even better of the great distance between the Lakeland tower and the new landing strip.

An administrative shop and photo lab will also be included in the powerhouse.

Special Projects

A Special Projects building is being erected on the existing landing to the landing strip and catapults. It will house NATF engineering and administrative personnel and will house longer space. Later will be used to prepare aircraft for test, install instrumentation, carry out tests and the like. Building will also house a machine shop which will be used to modify test equipment and provide facilities for an experimental and job shop.

Gravel facilities at NATF include: a runway between Lakeland and NATF's airfield and the 1,000 ft. runway which has been completed. It permits planes to land at the low speed up to 100 mph to the catapults in case the NATF runway is tied up with experimental work.

A turbine plant, the southeast end of the runway with the Recovery Site and the Steam and Air/Gas Turbine.

An access road has been built between the Naval Air Station and the Recovery Site. This road is intended to provide the fast track which is now in operation.

Most of these projects have been funded under appropriations totaling \$11,736,700.

Several additional facilities, as yet

unfunded and totaling \$11,736,700, are being planned for NATF.

Main support single item in the High-G facility, which alone is budgeted at \$4.8 million.

A 7,000 ft. runway parallel to but South of the 4,000 ft. runway will be the site of the proposed facility. Its purpose, Circle Tassell will, is to expand the limits of forces which can be imposed on human beings and equipment during catapult landings and arrested landings.

Carrier's flight deck length has been increasing only a little compared with airplane performance, so there is a growing need to make planes harder to get their airborne safely.

Lakeland with current catapult take about two seconds during which pilots are subjected to a maximum of about 5 G's.

If pilot, plane and its equipment could withstand doubling these forces, airplane makers would have considerably greater leeway in designing high performance into their carrier-based aircraft.

Parade for having a 7,000 ft. long runway is that the Navy wants to be able to catapult a pilot at speeds up to 100 ft. and keep him under observation for 15 seconds to see whether he is capable of living up to the experience after having been subjected to a given number of G's.

To accomplish this, a sled propelled by jet engines will be used. Jet engines will supply sustained thrust after the initial catapult.

If allocations upon the pilot's ability to live the plane immediately after launching, the Navy may be compelled to develop some means of controlling a plane's and its movements after completely automatically to give the pilot sufficient time to recover before flying over the controls (AW Aug. 19, p. 13).

Additional Facilities

An additional facility planned is a 4,300 ft. extension at the southeast end of the runway which will be used especially to test the feasibility of short field landings.

It 4,000 ft. runway can be built to handle high performance jets successfully without the 13,000 ft. runway now required, track safety and time could be saved.

The Short Field facilities will be used as a development program to test new methods of making such a concept work. Jet can be used to "test aircraft from behind" to help them accelerate to flying speed in the runway's 4,000 ft. Navy believes that jet can swing catapults beyond engines, and a steep and efficient way to give high performance planes the extra boost they need to take off at short distances. Jet can, being behind the aircraft will have

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Mk.5

The Martin-Baker Mk. 5 Ejection Seat is now being delivered in quantity to the United States Navy.



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is designed to arrest or deflect the ejection seat while the plane glides down during its take-off run.

A size track like loop built inside the runway will allow the jet car to swing around loops after take-off, as well as move forward as needed. After two or more jet cars are operating forward, with more swinging while others are landing, it is not unusual to be guided by track and controlled manually from cockpit or loop.

Portable Gear

An Experimental (possible) Aircraft Seat Size is being planned for the use of the 5,000 ft runway to ejection various experimental ejection gear designs to determine the most practical configuration.

An engineering building to support recent special projects building is being planned to take care of other projects of engineering equipment at NATF.

Griff Tansell listed the plans and proposals he needs in assistance to ejection seats to the weight and take off and landing speed systems of ejection seats being tested. He is pleased that this is not an accident, but it is a necessity, he feels, it can and will change at time passed. The list is:

- Douglas AD-6 (R1518)
- Grumman T1-1 in S2-2 (R1810)
- Grumman T1-5 (J46)
- McDonnell T1-12N (J71)
- North American AJ-1 (R1506, one J31)
- Douglas AD-6 (R1518)
- Douglas AD-6 (R1518)

Recovery system test into facilities are currently being operated by All American Engineering personnel. Testers during a test at a table positioned by a thick earth structure. Disturbances are taken as the ejection cable should snap and whip around the recovery area.

Deadend Test

After the seat goes down, a cloud of dust at the starting end of the track shows that the car is not ejection. Instead, instead of guiding the 25,000 lb deadend in slow. Griffs, all, the car/deadend gather speed and comes whirling down for ejection. Note the end of the runway the jet car is not automatically shut down and the jet car is linked to a smooth stop by using loaded friction plates clamping the guiding. It is in the center of the track. The deadend handles part of over 100 ft of guiding, which can be in slow forward test. Back at the back of the deadend engine the single ejection was tracked about three feet above the track. The 25,000 lb vehicle slowly down to a stop in less than

200 ft by the Mk. 7 Mod. 2 ejection capsule limited to a metal track at the right of the track.

The Mk. 7 Mod. 2 capsule, which the Navy is using at NATF, one ejection seat, one 100 ft of guiding. The Mk. 7 Mod. 1 capsule, one is used with the fleet, dispatches 24,000 lbs of weight.

This is how the ejection cable and engine are set up. The payload is attached above the track and is attached to the ejection cable which runs through down to the ejection capsule and a metal several times around it.

When a plane, engine the payload is pulled and the ejection cable which drives a large hydraulic piston into a cylinder in the ejection engine to absorb the plane's kinetic energy. A recovery net not control in the engine keeps the plane's distribution of a constant rate to reduce ejection loads on posed in pilot and plane, to a maximum.

Problems of cable vibration and possible technology was described by a NATF technician. When the ejection cable of an engine engages the track deck, payload, he said, "a small V-shaped hole is formed. The V hole gets progressively larger as the engine, called ejection cable, breaks the deck surface at a speed dependent on the aircraft's ejection velocity. Ejection seat speed may reach 750-1,000 ft/sec.

Stress Wave

"At the same time, the ejection cable creates a longitudinal stress wave in the cable itself which travels to the ejection capsule at a speed of approximately 10,000 ft/sec. Because of its high speed, the longitudinal stress wave travels to the ejection engine and returns towards the hook in quick time at the same rate, the slower transverse wave."

If the two cable stresses should happen to collide at the deck, shock, very high peak stresses are created in the cable which may cause it to rupture. Loads are also transmitted to the aircraft and ejection engine with adverse effects."

To overcome such failures, Navy scientists are developing various types of ejection dampers under a high ejection program. Designs tried so far with moderate success include special hydraulic damping devices and semi-rigid dampers using rubberized nylon. The problem are considered at the deck edge shows.

Griff Tansell said that NATF will, of necessity, postpone a big ejection seat test. He wants to go to ejection seats, which are being tested on a basis of the Navy's ejection seats flexibility and speed. But one ejection seat of ejection seats for an ejection seat. Ejection seat ejection type ejection seat, planned for Fiscal

1959 will cost \$14-million or more. A replacement of low ejection and an ejection is now working on NATF under Griffs Tansell. Personnel and budget plan will be an expenditure of \$614,000 in Fiscal 1959. By the end of Fiscal 1959, one ejection seat, personnel should expend to 200, by the end of Fiscal 1959, personnel should increase to 150 and budget to over \$1 million.

Griffs Tansell at NATF took place in February, 1955. Griffs Tansell was requested at the facility has been requested for October 1 of this year.

Speakers estimate that the \$1,000 ft. runway and 100 ft of guiding will be in operation by the summer of 1958 and the low size, track at the Navy's Southern Test Site will begin functioning in the fall of that year. Organization, NATF, will include the military and coordination control of Naval Air Development and Material Center (Johnston, Pa. Management and technical control is assumed by Griffs).

The new seat will be independent of Naval Air Material Center even though both will be working on aspects of the ejection gear and ejection program.

Logistic support, costs and the production, overhaul and repair, fiscal details, maintenance of buildings, industrial relations, and standard facilities will be provided by the Litchfield Naval Air Station.

OFF THE LINE

Canada's new record of production order from the Navy for the design and manufacture of an F4U-77 procedure trainer. But all the F4U-77 will be government. Griffs Tansell, 1955's Operational Flight Trainer simulator engine which will be converted to the F4U-77 procedure trainer. This is probably the last time that an absolute simulator has been given new orders in a procedure trainer, resulting in substantial success among. Canada has acquired 11 acres of land near the Buffalo, N. Y. High-Speed Aircraft Center to make into its own 15,000 sq ft plant being erected there before the end of the year.

Research Corp. has named Eastern Atlantic Manufacturing Co., of Atlanta, Ga., as a subcontractor for the states of Alabama, Georgia and Florida. Eastern Atlantic will handle such Researches projects in Florence, S. C. When time, paper, hollows and accuracy components.

Rubber-decking and floor, propeller and wing leading edges, interior seats or no interior has been put on the market by the French-Rac-Rac-Rac.



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box. Cited Althorn, the suits are based on electric resistance wires buried in the rubber. Mitt can be formed to almost any contour.

A new, lightweight, expendable pad let made of wool and corrugated paper is being produced by Bofing Pallet Co., Newark, Calif. That measure 40 x 46 in., can handle loads up to 4,000 lb. and weigh less than 51 lb. Weight is 14 lb. compared to 35 lb. for a wooden pallet of the same size.

Microfilm Division, General Mills, Inc., doubled its research and development programs during its last fiscal year which ended May 31. Its products and services, which included microfilm and microfilm-to-tape conversion, automatic control and picture stabilization, were sold chiefly under government contract. During the same period, company's total sales were \$127,703,089, \$116 million above last year's sales figure.

Resulting from licensing agreements have been arranged between two of the country's large aircraft hose fitting and assembly manufacturers. Under the agreement, Aerospac Corporation, of Jackson, Mich. long-time advocate of detachable, reusable hose fittings, has been granted rights to produce and sell new, permanently attached type of fitting incorporating custom patches and patent applications held by The Wes Division Co. of Cleveland, Ohio. The fitting features a patented hose gripping principle and is used with Teflon hose. Simultaneously, Wes Division secured rights to produce and sell Aerospac's "Super Grip" reusable fittings for Teflon hose which incorporate a lipoid principle. Both licensing agreements cover the United States and Canada. Wes will be a dual source of supply of both permanently attached and detachable fittings.

Design and development contract valued at \$174,000 for an electronic printing service has been awarded by Pan-Phil Graphic Equipment, Inc. from Rome Air Development Center, Goddard AFB, N.Y. Machine will accept original aerial photographs from which it will reproduce microfilm images. It can run the original negative at 500 lines per inch at a speed of 500 lines per minute and can incorporate enlargement or reduction.

William Band & Company, Inc. of Williamsport, Conn. has appeared as exclusive sales representative for the Turbo Multisector Cable the Los Angeles firm of Cable & System Engineering, Inc. (TMS) Santa Monica. B&C Multisector cables are used in various computers, data processing, remote and television applications.



These Soviet plans showing pressure suits which are similar to composite U.S. suits.



WRAAF is probably only model high altitude gear includes brother helmet, oxygen mask.



DETAIL of Soviet high altitude test pilot.

Pressure Suits for Soviet Pilots Have Similarities to U.S.

Details of late-model Russian high altitude pressure suits are evident in these four pictures to reach the U.S. Soviet garments show similarities to American suits (upper left). Suit worn by man kneeling has very many points in common with a USAF design. It is possibly a Russian copy or even a captured Air Force suit. Other two suits are obviously full-pressure garments with some resemblances to the Goodrich suit (AW July 1, 1967).

Note ends of wrist where gloves meet on Unibell and on right chest of full pressure suits a rectangular connector, containing electrical connection for head set, radio, etc., and probably, but not positively, the oxygen supply.

Round clamp about above the left knee may be pressure sensing device to relieve suit automatically in an emergency.

Close-up of Soviet pilot (above) shows detail on hinge of helmet and of what appears to be a latch just below the oxygen inlet. The device may record "survival" of the helmet blow as it could be partly for padding to protect the back of the pilot's head.

Picture of pilot descending ladder from rocket (right) shows that oxygen mask is worn under his helmet, but ditch bowl would probably still be present.

Close-up of pilot in rocket (lower left) showing face as further helmet, ditch bowl would probably still be present.



PA87 descending ladder from rocket carries aloft in left hand which is probably a ditch or further helmet. It is not the crash type to protect his head under helmet. Russian appears to be large and awkward in comparison to Goodrich-developed boots.

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Division of Northrop Corporation, a unit of Lockheed Martin Corporation

WHO'S WHERE

(Continued from page 23)

Changes

Charles J. O'Donnell, general manager, Semiconductor Business Division, Fairchild Camera and Instrument Corp., Springfield, N. Y.

Robert A. Wolf, land-vehicle systems department and Dr. David A. Kahn, land-vehicle systems department, Systems Research Division, General Automotive Laboratory, Buffalo, N. Y. Also Maurice M. Kneiberg, land-vehicle department, Walter P. Reuther, land-vehicle mechanics, and King D. Fink, land-vehicle control department.

Frank M. Schindler, chief engineer, Car Study Corp., Buffalo, N. Y. Also Dr. William D. Lyford, director, newly established training department.

Reginald Holbrook, regional sales representative for various products (Sylvania, Eastman), Learning Division, Avco Manufacturing Corp., Stratford, Conn.

George C. Pelt, manager European sales office (General, Scotchbrite, General), division of General Dynamics Corp., San Diego, Calif. Mr. Pelt will be assisted by Bill D. Cape, Philip Ward and Theodore Lorenz.

L. M. Berry, general manager for Toronado Electric Manufacturing Co., San Francisco, Calif.

Roy C. Cook, head applications engineer, Pacific Semiconductor, Inc., Culver City, Calif.

H. N. Sevedge, manager Electronics Department, Aerospace Development Corporation, of Goodyear Aircraft Corp., Santa Barbara, Calif. Also Herbert H. Helms, aerospace system support group, Aerospace Development Corp.

Charles C. Neighman, Jr., confidential assistant and public relations, Getty Industries, Inc., Los Angeles, N. Y.

Gordon Smith, chief engineer, Packard Engineering Corp., Santa Monica, Calif.

Stanley J. Manaster, assistant to the manager of America Sales, Cals Service Petro Sales, Inc., New York, N. Y.

John Butler, CD Development, field sales manager, Cleveland Pneumatic Tool Co., Cleveland, Ohio.

Edward Wolf, manager-product products department, Aviation Products Division, Goodson Tire and Rubber Co., Akron, Ohio.

Marle E. Smith, manager, Electronics Division, Atlas Precision Products Co., Philadelphia, Pa.

Leonard E. Kent, chief microwave engineer, The Radio Shack Corp., Melville, N. Y.

Harold S. Glusman, assistant general manager, Electronics Division, Scotchbrite/General, division of General Dynamics Corp., Rochester, N. Y.

Clark N. Williamson, chief engineer, General Engineering Division, Arvin Products Co., Middle River, Md.

William N. Hall, manager of equipment, The Aircraft Plant, Fairchild Aircraft Division, Fairchild Engine & Aircraft Corp., Hagerstown, Md.

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It is almost unbelievable that a society such as ours, which has profited so vastly from an unceasing accumulation of knowledge, should allow anything to threaten the wellspring of our learning.

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The crisis that confronts our colleges today threatens to weaken seriously their ability to produce the kind of graduates who can assemble and carry forward our rich heritage of learning.

The crisis is composed of several elements: a salary scale that is driving away from teaching the kind of men most qualified to teach; overcrowded classrooms; and a mounting pressure for enrollment that will double by 1967.

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